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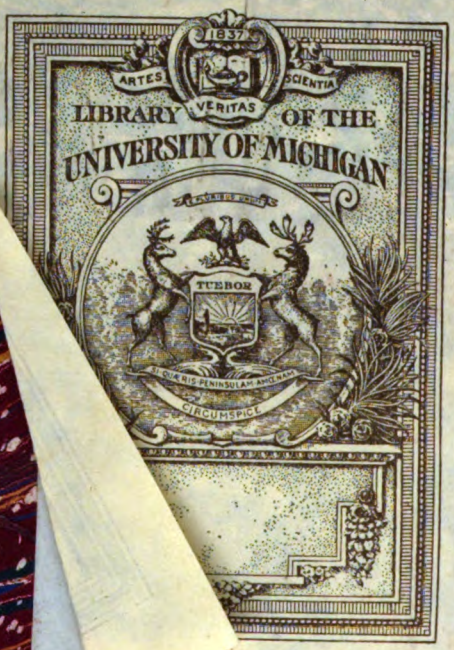

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The Journal

OF THE

Royal United Service Institution.

VOL. IV. 1860. No. XII.

LECTURES.

Friday, January 20th, 1860.

Captain E. G. FISHBOURNE, R.N. C.B. in the Chair.

THE MILITARY AND SANITARY INSTITUTIONS OF THE ROMAN ARMIES, AND THE CAUSES OF THE DECAY OF THE LEGIONS.

By JAMES BIRD, Esq., M.D. F.R.C.P., and late Physician-General, Bombay Army.

THE Romans, who were a warlike, wise, and prudent people, never thought it unworthy of their reputation, or their genius, to adopt from all nations whatsoever they found practically good for their purpose, either in military discipline or the operations of war. They were not less open to conviction in all that concerned the health of their soldiers, whether at home or abroad; and pursued the best methods for checking the spread of infectious disease both among men and animals. The study of their military and sanitary institutions, therefore, is inseparably connected with their history and their greatness; and the evidence of such history brings conviction that this greatness ever flowed and ebbed together, in proportion to the perfection of their military discipline. No people were ever more sensible than they how skill and practice, in the art of war, were superior to valour, and could secure for a few victory over armed but undisciplined hosts. By a strict observance of discipline in their camps, by unremitted and constant training to the exercise of arms, by unwearied cultivation of all the

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arts of war, and by a strong patriotic sense of their own interest, in the prosperity and preservation of a free government, the Roman soldiers derived confidence and courage from a knowledge of their profession; and were, for nearly nine centuries, invincible against the impetuous but irregular onset of barbarians in battle. Inferior in numbers and stature to the Gauls, Germans, and Spaniards, and yielding to the Greeks superiority in genius and knowledge, yet the Romans, under the Republic and the first Emperors, became masters of the fairest and most productive provinces of the ancient world, and spread the terror of their name among the most remote nations of the earth.

Though the discovery of gunpowder and the introduction of fire-arms have produced a difference between the ancient and modern practice of the art of war, yet the principles of military organisation and of warlike operations have been, and ever will be, the same, notwithstanding modifications and improvements of destructive instruments of warfare. Much of what we now carefully follow, in our system of obtaining recruits rather from the provinces than the towns, of enlisting men at the proper age of manhood, of attending as much to the constitutional vigour of men as to the greatness of their stature, of examining the features, the eyes, and make of the limbs, as indicating the qualities of good recruits, and of rather selecting them from the manly trades of huntsmen, smiths, and carpenters, than from the more effeminate ones of confectioners and weavers, was fully appreciated and attended to in raising and organising the armies of ancient Rome.* But in the latter times of the Roman empire, when, amidst the general corruption of manners, the decay of patriotism, and the avaricious exactions of officers in command, recruits were less carefully chosen than they had been under the Republic and first Emperors, neglect of this first of duties for the good organisation of the Roman armies became, among other causes, a source of their weakness and decay. It may be profitable, but at all events interesting, for us to look more minutely than we are wont to do into the military practices of the Romans, through the light of their own historians, and to learn what modern customs have borrowed from them, or may now claim as improvements of more recent times. A careful and unbiassed examination of this subject might, perhaps, dispose us to make some abatement of our modern claims and pretension of superiority, over those who went before in reducing a knowledge of arms into an art, or in moulding it into precepts for the strategic manœuvres of general engagements, or the manner of conducting sieges.

The Greeks, in these as in other matters, were the preceptors of the Romans. The military science of both peoples embraced two distinct heads, namely, strategy or military command, and a knowledge of tactics, or military evolutions. The one was called the *art imperatory*, and the other the *art of tactics*,† a combined knowledge of these being requisite to form a great and accomplished general. The latter could not, in the long run, secure success in war, unless the general in command, from due foresight and acquaintance with things necessary, made all requisite arrangements for provisioning his army, maintaining the health of his soldiers, enforcing discipline, and preparing, with due care and science, all warlike implements and engines, that might be called for in warlike operations.

* Vegetius de Re Militari, lib. i. c. 2, &c. † Xenophon, Cyropæd. lib. viii. c. 27.

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Among the Greek authors who directed attention to these subjects, and whose names are frequently quoted by later Roman writers, were, Iphicrates, Evangelus, Pyrrhus the celebrated King of Epirus, and his Thessalian minister Cineas, who appears to have epitomised the many volumes which Æneas wrote on the theory and art of war. But the original and last only of these works is now extant, and all that we know of the others must be gathered from the later Roman writers, beginning with Polybius, the master and companion of Scipio Africanus; and who, in addition to his excellent history of the wars of the Romans, wrote a system of tactics which has been lost. Professionally and practically he was well acquainted with military operations, and was present with Scipio at the siege and destruction of Carthage B.C. 140. Many passages of the history indicate his extraordinary skill in matters of war. In an extract from the sixth book he has vividly described the constitution of the Roman legions in those patriotic ages of the Commonwealth when, as Gibbon observes, and like ourselves at this moment, the use of arms was reserved for citizens who had a country to love, property to defend, and a duty to maintain. In latter times of the Emperors Trajan, Hadrian, the Antonines, and Valentinian the Second, we possess the more elaborate treatises on tactics of Ælian, Julius Frontinus, and Flavius Vegetius, the last of whom is the most complete expositor of all the Roman military institutions. He was the co-temporary, as it appears, of the Emperor Valentinian II. A.D. 375-392, and not only wrote the military institutions of the Romans, but a work on the distempers of horses and cattle, and the best methods of preserving their health, and preventing the spread of infectious diseases.

An acquaintance with military history, and the classical records of the origin and art of war in former ages, has ever been deemed a part of necessary acquirement for an accomplished military leader, and what had in this respect been learned so well by Cæsar gives life and vigour to the vivid narratives of his own campaigns. Modern military customs, in every department of the service, have been borrowed from the Greeks and Romans. Surely then a classical and historical knowledge of what they knew on the subject of organising armies, of training and exercising soldiers, of supplying and provisioning troops, of preserving their health, of disposing them in order of battle, of entrenching their position before superior forces, and of attacking and defending fortified places, will be no mean foundation for special training in the more enlarged and improved system of modern warfare. On all of these heads Vegetius is capable of supplying useful information, and he drew his inspiration, as he tells us, from the commentaries of Cato, Celsus, Trajan, Hadrian, and Frontinus on the Art of War.

In this lecture I propose to bring briefly before you—

1st. The constitution of the Roman armies and military establishments, under the Commonwealth and the Emperors, their discipline, training, and equipment.

2nd. The mode of conducting and provisioning their army, and the means of preserving its health.

3rd. Their system of selecting defensive military positions fortified by nature and art.

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4th. The causes of the decay of the legions.

1st. The Roman armies consisted of the infantry and cavalry of the legions, of an establishment of engineers and miners, accompanied by all the machines necessary for besieging and defending fortified positions, and of the auxiliary or mercenary troops made up of different nationalities, that were bound together by no common tie, either of unity of discipline, acquaintanceship, or natural disposition.* "But Roman bravery," says Vegetius, "was in the main powerful according to the discipline of the legions;" an observation not to be lightly passed over or lost sight of by ourselves, who, in organising means of national defence, by our militia and rifle corps, have adopted a system at once the most economical and best suited to the self-reliance and habits of the English people. In the best times of the Commonwealth the Roman citizen was individualised into the Roman soldier, and it was by a like system of national military development, and by perfecting practice in the exercise of our national weapon the bow, that our countrymen won the battles of Poictiers and Agincourt.

The auxiliaries were in many respects similar to our own subsidiary troops in India; but the number of legionary soldiers in the army was generally more considerable than that of the auxiliaries. The recruiting and enrolment of the soldiers of the legions, on the authority both of Polybius and Vegetius, were carried out with the greatest care and attention under the Commonwealth,† due regard being paid to the essential merit of descent, age, strength, and military stature, things that were less attended to in the latter days of the Empire. The last author lays much stress on the necessity of attending to these things in the following words: "Juventus enim, cui defensio provinciarum, cui bellorum committenda fortuna est, et genere si copia suppetat, et moribus debet excellere: honestas enim idoneum militem reddit. Verecundia, dum prohibet fugere, facit esse victorem. Quid enim prodest si exerceatur ignavus—si pluribus stipendiis moretur in castris? Nunquam exercitus profecit tempore belli cujus in probandis tyronibus claudicarit electio,"‡—"For the youth, to whom is committed the defence of the provinces and the fortune of war, ought, if the supply may admit, to be distinguished by birth and for conduct: for a sense of honour makes the fit soldier. Self-respect, while it prevents flight, makes him victorious. For what does it profit if the dastard be drilled—if through several campaigns he should be lingering in the camps? That army never was serviceable in time of war whose organisation was defective in making choice of recruits."

Before being admitted into the service, or distinguished by the military mark, the recruits were examined in respect of their physical and mental capacity for duty, and then put on trial as to whether they possessed the requisite degree of military self-reliance;§ they had then an oath administered to them with imposing solemnity, that they would be obedient to their commanders and execute their orders to the utmost of their power.‖ Having passed through these preliminaries of admission, they were taught

* Vegetius de Re Militari, lib. ii. c. 2.
† Polybius, lib. vi. c. 1; and Vegetius de Re Militari, lib. i. c. 1 to 8.
‡ Vegetius de Re Militari, lib. i. c. 7.
§ Vegetius de Re Militari, lib. i. c. 8. ‖ Polybius, lib. i. c. 63.

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the military step, exercised to run, to leap, to swim, to carry heavy burdens, to cut and thrust with the sword, to acquire the familiar use of all arms, offensive and defensive, and to perform a variety of evolutions necessary for their movements in battle. The recruits were thus carefully chosen, and, having been daily exercised for the space of at least four months, were then thought sufficiently prepared for being embodied in the legions.

In the time of the Commonwealth, when their military instructions were drawn from the most perfect model of Roman discipline, the number allotted to each legion was four thousand two hundred, and sometimes five thousand, when any great or unusual danger appeared. "Never more than two legions, besides auxiliaries," says Vegetius, "were at this period sent under one consul, against the most numerous forces of their enemies, such being their perfect discipline and self-reliance that they were found equal to all the exigencies of war." In later times, however, under the Emperors, the imperial legions, as described by Gibbon on the authority of Vegetius, were divided into ten cohorts and fifty-nine companies, under the orders of a corresponding number of tribunes and centurions. They consisted in the whole of six thousand one hundred heavy-armed foot soldiers, associated with a body of cavalry amounting to seven hundred and twenty-six horsemen (figs. 1, 6, 7), who with the light-armed foot, consisting of the *ferentarii*, archers (fig. 4), slingers (fig. 3), and *balistarii*, composed the wings

FIG. 1. — Legionary Soldier; from the column of Trajan.

FIG. 2.—One of the Hastati; from the column of Antoninus.

FIG. 3.—Slinger; from Trajan's column.

of the army. The first cohort, which exceeded the others in the number and quality of the soldiers, selected from men of family and education, was appointed to guard the golden eagle and the images of the emperors (fig. 5).

The legionary troops were either heavy or light armed. The former, drawn from men in their full strength and vigour, consisted of the *hastati* (fig. 2), the *principes*, and *triarii*, while those younger and of inferior condition were set apart for light-armed troops. From the foundation of the city to the time of the Emperor Gratian, A.D. 375, the arms of the foot soldier were, a helmet, a cuirass or breastplate, greaves on the legs, and a buckler on the left arm. Their missive weapons were a double-edged Spanish sword, suited to either give point or to strike; sharp, iron-headed javelins a foot in length, carried in the buckler and used as darts; and

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the heavy javelin, six feet long, which was launched with great effect against cavalry at the distance of ten or twelve paces.

FIG. 4.—German Archer; from the column of Antoninus.

FIG. 5.—Standard-bearer; from Trajan's column.

The armies of Rome were commanded by officers of liberal birth and education, among whom the præfect, on whom devolved the chief command, in the absence of the emperor's lieutenant, was considered the special officer of the legion. The tribunes, centurions, and the soldiers in general, were under his orders, and on him devolved the duty of maintaining strict discipline and obedience, and of exercising daily the

FIG. 6.—Legionary Trooper; from the column of Antoninus.

FIG. 7.—Mounted Archer; from the column of Antoninus.

legionary horse and foot. Inferior in rank to this officer there were also præfects of the camp, and of the engineering train of miners, workmen, and mechanics. The authority of the former extended over the sick and the physicians in charge of them; and to him was assigned the duties of selecting the site of the camp, of superintending the entrenchments for its defence, of having charge of the baggage, and of inspecting the tents and huts of the soldiers. He had also the camp carriages and horses at his disposal, and all the war engines were under his direction. The præfect of the engineering train and workmen had the duty of constructing barracks in the winter camps, and of making and repairing the various

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kinds of engines and machines necessary for the attack and defence of places.

2nd. The Romans were fully alive to and sensible of the truth of the adage, "Sæpius enim pænuria quam pugna consumit exercitum, et ferro sævior fames est,"* "For want often wastes an army more than battle, and famine is more terrible than the sword." In recognising the force of this, they made it a point of supreme importance and necessity, when entering on a campaign, to secure plenty of supplies for their armies. Provisions of all kinds, forage, and corn, estimated in quantities according to the number of troops, horse and foot, were ordered to be provided by the provinces, and stored up in the strongest and most convenient cities. By careful management of the magazines, and a frugal distribution of the provisions to each man without distinction of rank, sufficient supplies for the army were generally secured. The soldiers were thus provided with wood in winter, water in summer, and with corn, wine, and vinegar at all times. The Roman commanders knew full well the value of foresight in these matters, without which the discipline and valour of their finest armies were as nought, while their numbers melted away like water in the desert.

Nor were they less careful to provide against the contingencies of disease among their troops, and to adopt means for preserving the health of their soldiers. They paid the greatest attention, therefore, to the choice of a healthy situation for their encampments, remote from unwholesome marshes, and provided with good water; not to expose the soldiers without tents to the heats of summer, or on dry, arid plains without shade or shelter; to supply them in winter with fire-wood and warm clothing, and never to expose them during night to either frost or snow; and to begin their march by break of day during the extreme heats of summer. They considered hard, marshy water a kind of poison, and the cause of epidemic diseases. It was imposed as a special duty, therefore, on whoever was in chief command of the troops, and also on the tribunes, that the soldiers should be duly practised in the military exercises, such being more effectual than medicine in preserving their health; while those who were sick were supplied with suitable diet and diligently attended by the physicians. Frequent changes of encampment were made, during summer and autumn, in order to obtain good water and prevent the corruption of the air: in short all the sanitary provisions of military hygiene, which through the public press and the authorities have been enjoined in this country on all concerned, as if parts of a new science discovered but yesterday, were fully appreciated by and acted on by the Roman commanders.

It was thought indispensable that the commander-in-chief, on whose foresight and bravery depended the fortunes of his country and the glory of the state, should not only have perfected himself in the science of tactics and the art of war, but be well instructed in the means of husbanding his resources and preserving the health of his men. He was expected to study the strength, spirit, and composition of his army, whether made up of raw recruits or veteran soldiers, and to perfect discipline and order by strictly enforcing obedience to his commands, under all the contingencies of place and circumstances.

* Vegetius de Re Militari, lib. iii. c. 8.

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In the 3rd place the Roman generals were sensible that not only was the success of a campaign mainly dependent on those things, but that to secure victory they should endeavour to obtain the advantage of high ground and superior situation before disposing their troops in order of battle. They could fully estimate the advantage of occupying any elevated position, rendered more formidable, to a numerous enemy in front, when strengthened against their attacks by either a wood or a morass. They could thus drive back their antagonists with greater impetuosity, throw their darts and javelins with more effect, and force back their struggling assailants with almost certainty of defeat. When drawing up their troops also, in order of battle, they placed the more experienced and veteran soldiers, called *principes*, in the first line; posting in their rear a second line of select infantry soldiers, called *hastati*, armed with cuirasses, javelins, and pikes. These two lines of soldiers, who were experienced and heavy-armed, were never to break their order, even to join in pursuit; but were to remain immovable as a wall, and receive the enemy's charge with steadiness and stability. Behind these were drawn up two other lines of light armed foot, the *ferentarii* and *martrobarbuli*. The former consisted of light active soldiers and young archers, expert in the use of the javelin; the latter were composed of the youngest archers, skilled in the use of the small javelin and armed with light shields. These two bodies, like our light infantry soldiers, were to begin battle by advancing to annoy the enemy with their darts and arrows. If they put them to flight they pursued them in conjunction with the cavalry; but if repulsed they fell back on the two first lines, retiring through the intervals to the rear; while the two foremost lines sustained the whole weight of the enemy's attack. The cavalry were always drawn up on the wings of the infantry.

It was also part of the Roman system of war, in erecting fortified cities or castles for their magazines, to select for their site high and steep places surrounded by the sea, or made more difficult of access by a marsh or a river, and these were artificially made stronger by means of walls, ramparts, and ditches. For the construction of ramparts parallel walls were built at short distance from each other, and filled up with the earth taken from the ditches. The inner wall was considerably lower than the outer, so that the space when filled up should present a graduated slope from the city to the top of the rampart. The ditch also was made broad and deep, and so flooded with water that the depth of it might effectually prevent the mining operations of the besiegers from without. The gates of the fortification were strengthened by the woodwork being covered with leather and plates of iron; and in some cases there was an additional work thrown up before the gate, with a portcullis suspended at the entrance by means of iron rings and ropes, and capable of being let down on the approach of an enemy. The magazines of these fortified places were well stored with coals, wood, and military arms of all kinds, and quantities of bitumen, sulphur, and liquid pitch were kept ready for burning the machines of the besiegers. A vivid and heartrending description of the use and destructive effects of these things, both by the Jews and the Romans, is presented to us in the various accounts we possess of the siege and destruction of Jerusalem by Titus.

I come now in the 4th place to trace the causes by which the armies

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of Rome, long invincible, and which had been the terror of her enemies, so fell away from their pristine perfection and discipline as to lose the respect of their barbarian enemies, from the middle of the fourth to the end of the fifth centuries of the Christian era.

The military constitution of the ancient legions, as I have described them, prescribed that the soldiers should be recruited from the best and bravest of the Roman citizens, who were animated, in the performance of duty, by a truly patriotic love for the protection and glory of their country; while they saw that public places of rank and emolument were open to their ambition, and obtainable as the rewards of their own merit, exertions, and long services. So long as such were the prizes to be contended for, the Roman soldiers cheerfully gave themselves up to all the labour and rigidity of strict military discipline, and all the danger and hardships of foreign service. But soon after the age of the Antonines, when, through a long peace, the general felicity and luxury of Roman citizens, the love of refinement, and the corruption of manners, the manliness and greatness which had been fostered under great and popular governments now gave way to effeminacy and degeneracy, the Barbarian countries of Europe that had been subdued supplied the legions with excellent but not patriotic soldiers; the legions were less carefully recruited than they had been, and filled with mercenaries; the employment by the Emperors of prætorian guards for the protection of their persons; the lost sense of national honour, once nourished by creditable ambition, and the want of public courage, all contributed to weaken the discipline and obedience of the Roman armies: till, as Vegetius says, the name of Legion remained, but its strength and substance were gone; the only fountain of honour or of justice was the capricious will of the sovereign, who trusted for defence to a mercenary army; which demanded from him concessions in proportion as the need of his government increased.

The Roman soldiers thus yielded to the natural indolence and indulgence incident to human nature; threw aside their obedience and allegiance; and gave way to the effeminacy of the times. They complained that their duties were too severe, their arms too heavy, the rewards too distant, and the discipline beyond their strength. They were consequently permitted to lay aside their armour, to make use of lighter weapons of defence, and to relax their accustomed military exercises, which had rendered them superior to their enemies. The consequences of all these things were, that when they were brought into battle against the hardy Goths and Huns of the North of Europe, who were expert and practised in the use of the long bow, the Roman armies fled before them in dismay.

In the experience of these things among the Romans, we may derive a not unprofitable lesson for ourselves, "that constant and well-appointed preparation for war is necessary to preserve peace."

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Friday, January 27th, 1860.

CAPTAIN E. G. FISHBOURNE, R.N. C.B., in the Chair.

THE HISTORY OF THE HORSE, AND HIS COMPARATIVE VALUE FOR MILITARY AND OTHER PURPOSES.

By JOHN CRAUFURD, Esq., F.R.S., &c.

The horse—the noblest conquest of man over the lower animals, although not the most difficult, for in this respect it must yield to the elephant, as in utility it must to the ox—is at present nowhere found in its original wild state, although the ass and the ox unquestionably are so. A true wild horse was supposed to exist in the mountains of Thibet; but a specimen of this animal has at length been brought to England, and is now to be seen in the gardens of the Zoological Society. It is, however, of the family of the asses, somewhat taller than the true wild ass, lighter in the shoulder, longer in the neck, with shorter ears and a more horse-like head. It is, in fact, I am assured by an eminent naturalist, my friend Dr. Falconer, the Djiggatai of the Moguls, and hunted by them for its flesh—considered by Tartars to be better venison than that of any deer.

In the domesticated state, the horse has immemorially existed in every region of the Old World, the Arctic excepted. His disappearance from the absolutely wild state is probably to be accounted for from his natural *habitat* being the open plain; from the facility with which he would hence be captured, and, when captured, tamed, domesticated, and made useful.

As we now see him, the horse consists of an almost infinite variety, differing in size, in form, in colour, and even in disposition. Much of this variety has, no doubt, been the work of man, but it is so great that it is difficult to believe, when we consider the insuperable difficulties to intercommunication which existed in early times—always rude times—that all the widely differing races could possibly have sprung from a single species, or that time, soil, and climate could have produced so prodigious a diversity. To account for it, then, I think we must come to the conclusion—and I am not the first that has come to it—that there must have existed originally a great number of closely-allied species capable of commixture, and of producing a fertile offspring. Such is certainly the case with the ox and the dog, and probably even with the human race itself.

For this inference a good deal of evidence might be produced. Thus, language countenances the theory. In every original tongue of countries in which the horse appears to have been indigenous, so far as

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I have been able to discover, it has a peculiar and distinct name. Thus, it has a distinct name in Greek, in Latin, in German, in the Celtic tongues, in Persian, in Arabic, in Sanscrit, in the languages of the South of India, in the Hindu-Chinese tongues, and in the languages of the Malayan Islands. Sometimes it has two names, a native with a foreign synonym, as in Irish or Gaelic and in Javanese—in the first case the synonym being Latin, and in the last Sanscrit. In countries in which the horse had unquestionably no existence, it naturally takes its name from the language of the people who introduced it. In South and Central America, and the Philippine Islands, the name is Spanish, taken from the Latin; and in North America and Australia it is English.

There are two broad distinctions in the horse—the full-sized one and the pony—which seem to point, at least, at two distinct aboriginal races or osulating species. No change of climate or skill in breeding, supposing there be no crossing, will convert the one into the other. In most countries both exist together; but in some, one of them only exists. Thus, in the inter-tropical countries which lie between India and China, and in the islands of the Indian Archipelago, the pony only exists, and the full-sized horse is as unknown as the ass or the camel. In the languages of these countries, consequently, there is but one name for the horse, while in the languages of Hindustan and Persia there are distinct terms for the horse and the pony. In Arabia the horses are all comparatively small and do not materially differ in size; so there are no ponies, and, consequently, in the copious Arabic language, no distinct terms for horse and pony. It may be suspected that the same was the case in some of the poorer and remoter parts of the British islands, for in the Celtic languages the pony has no other name than "little horse."

Soil and climate, independent of the care of man in feeding and breeding, of which, in the ruder states of society, the horse receives little or none, seem to have very little influence on its size, form, or disposition. In the temperate western parts of Europe it is found of a size never seen in any part of Asia or Africa: it thrives even in countries in which nature had not originally planted it, and this applies to every region of America, from the equator to Terra del Fuego. Over this wide region, with some allowance for patent neglect, it is still the Spanish horse introduced about three centuries ago. In the absence of powerful carnivorous animals, and with abundant pasture, it there multiplies much faster than it could at any time have done in any part of the Old World,—so fast indeed as, in many cases, to have regained its liberty and to have returned to its wild state, yet ever retaining that variety in colour which marks its once subjection to man.

Like America, the Philippine islands were found without the horse. The Spaniards introduced it, but in this case they introduced the Spanish horse from South America, and along with it the pony of the neighbouring Malay archipelago, and the result is, that the breed of horses of these islands is a kind of galloway, intermediate between the two races. Here, too, under conditions as favourable as in America, it has run wild.

The Southern hemisphere opposes no obstacle to the successful multiplication of the horse, since we find the different breeds of the

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English horse thriving nearly as well in Australia, New Zealand, and the southern extremity of Africa as in the country from which they came. In countries to which the pony only is indigenous, the full-sized horse thrives perfectly, as is seen from its introduction, in very recent times, into Java and the country of the Burmese.

The notion that all the different races of the horse have proceeded from one original stock has no warranty from history. As long as the horse receives no special care in breeding, he undergoes no change, and such care he only receives in a considerably advanced state of society, or where, as in the case of the Arabs, he is an object of special and peculiar importance. The half-wild and neglected horse of South America, does not materially differ from his progenitors introduced by the Spaniards above three hundred years ago, and our own Shetland and Welsh ponies most probably differ in no respect from their predecessors of the time of the invasion of Julius Cæsar. The squab, strong, and enduring Tartar horse of the present day is, in all likelihood, the same kind of animal, by help of which Attila, and Gengis, and Timur effected their conquests,—the same with which the Tartar tribes subdued China twice over, and against whose incursions a wall of 1,500 miles long was no security. It is the same, too, which the allied armies will encounter in their march on Pekin—a shaggy rough galloway, under fourteen hands.

Through the care of man, it is needless to add, vast improvements have been effected in the horse. This care, as is well known, has been long bestowed by the Arabs. It is certain, however, that in Arabia, as in every other country, a native race must have existed to afford the materials for selection. In the sacred writings Solomon is represented as purchasing his stud, not in Arabia, but in Egypt, from which it has been very hastily inferred that the last of these countries, and not the first, is the parent country of the high-bred Arab as we know him. For this notion, however, I can see no good foundation. The Egyptians of the time of Solomon were a civilised and wealthy people, with abundance of horses, and the Israelite king naturally went for his to the best or most abundant market, which was Egypt. The Arabs of the same period were a rude, nomadic, and isolated people, and so they continued for a long time after, until, indeed, Mahomed, in the seventh century of our own time, "breathed," as Gibbon expresses it, "the soul of enthusiasm into their savage bodies," and made them a united, a conquering, and in many respects a prosperous people. It was most probably then only that they began to pay special attention to the breeding of the horse, the result of which has been the production of that animal which, in so far as form, bottom, and beauty are concerned, is considered the perfection of the blood horse. He is, however, in size what we should call a mere galloway, and when in perfection seldom exceeds fourteen and a half hands high. He cannot be said to be master of a weight exceeding ten stone, and yet there is some adaptation of his strength to the usual class of riders he has to carry, for the man of Asia is much lighter than the man of Europe. In India it has been ascertained that on an average the Indian trooper is lighter than the English light dragoon by no less than two stone and a quarter. The difference between the Englishman

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and the Arab is probably not so great, but still it must be very considerable.

The Arab horse has been justly praised for its gentleness and docility, qualities generally ascribed to its rearing and tuition. I am, however, satisfied that this character is far more owing to the natural temperament of the race, for it sometimes happens that an Arab is vicious, and, when he is, he is exquisitely and incorrigibly so. There is one quality in which the Arab horse perhaps excels every other, endurance of continuous labour. A little Arab of 14 hands, for a bet of £500, ran 400 miles in five consecutive days, or at the rate of eighty miles a day, carrying 10st. 7lb. This feat was performed on the race-course of Bangalore, but thirteen degrees distant from the equator. The horse was Jumping Jemmy, and the rider, as meritorious as his horse, Captain Horne, of the Madras Artillery.

I will give you, however, the description of a genuine Arab, more lively as well as more amusing than any other that I am acquainted with. It is that of Evelyn, in excellent quaint English. In the year 1683, the Turks, under their Grand Vizier, invested Vienna, and the Emperor of Germany and his ministers fled. John Sobieski, elective King of Poland, came to the rescue. The Turkish army was entrenched, and the Grand Vizier, in Turkish fashion, was taking the matter coolly and quietly, for he was seen from a neighbouring height smoking his chibouk and sipping his coffee. Polish blood could not stand such a sight, and the Polish cavalry, lance in hand, cleared the entrenchments, entered the Turkish camp, routed the army, and pursued it to Hungary and beyond it. For this service, in less than a century, the Poles were requited, after a peculiar fashion, by having their country partitioned, and a large slice of it taken by the descendants of those who but for them might have been now crying "Bismillah" instead of being in league with the Pope. Some Arab horses were among the spoil, and were brought for sale to England, and exhibited before Charles II. The following is the account given of them in the Diary. "Dec. 17th, 1686. Early in the morning I went into St. James's Park to see three Turkish or Asian horses, newly brought over and first shown to His Majesty. There were four, but one of them died at sea, being three weeks coming from Hamburgh. They were taken from a Bashaw at the siege of Vienna, at the late famous raising of that leaguer. I never beheld so delicate a creature as one of them was, of somewhat a bright bay, two white feet, in all regards beautiful, a blaze: such a head, eyes, ears, neck, breast, belly, haunches, legs, pasterns, and feet,—in all regards beautiful and proportioned to admiration, spirited, proud, nimble, making halt, turning with that swiftness and in so small a compass as was admirable. With all this, so gentle and tractable as called to mind what Busbequius speaks of them, to the reproach of our grooms in Europe, who bring up their horses so churlishly as makes most of them retain their bad habits. They trotted like does, as if they did not feel the ground. Five hundred guineas were demanded for the first, three hundred for the second, and two hundred for the third, which was brown. All of them were choicely shaped, but the two last not altogether so perfect as the first. It was judged by the spectators, among whom was the King, the Prince of Denmark, the Duke

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of York, and several of the Court, noble persons skilled in horses; especially M. Faubert and his son, Provost Masters of the Academy, and esteemed of the best in Europe, that there were never seen any horses in these parts to be compared with them."

The present races of the English horse are, with the exception of the ponies, a very mixed breed. Our draught horses are in a large degree derived from the horses of Flanders, and it is by no means improbable that our Saxon forefathers brought with them some of the heavy horses of Holstein and Sleswick. An indigenous full-sized horse, however, certainly existed in the time of the Roman dominion. It was this, most probably, that was used in the scythed chariots of the Britons. It was, at all events, possessed of such good qualities as to be much sought after on the Continent. From this horse and the blood of the Arab has sprung our famous race-horse, far exceeding in fleetness all others. The Arab, for breeding, seems first to have been introduced in the beginning of the seventeenth century, in the reign of James the First. In about a century's time, or ending with the time of Queen Anne, all the benefit derivable from the Arab blood seems to have been completed. It is certain, however, that the original unmixed English horse, from which the race-horse derives its size and strength, must have possessed excellent qualities, for we have in proof the fact that Flying Childers, supposed to be the fleetest horse that England ever produced, was the immediate offspring of an English mare by the Darley Arabian, a genuine Arab of the Desert, —that he was, in other words, a half-bred, a fact which seems to be implied by his portraits, for, although his other points appear unobjectionable, he has a large coarse head, such as a true Arab never had. The celebrated Eclipse traced his pedigree not very remotely to the Godolphin Arabian, which has been supposed by some to have been a Barb, but I fancy only from the fulness of his crest. If the account I have heard be true, that he was a present from the Sultan to Louis the Fourteenth, the probability is that he was a true Arab, as the Sultan could easily have got one without going to the mixed blood of Barbary.

Although, however, no account is given of the dam of Flying Childers, it is likely that she may have had some Arab blood, for the horse was of the time of Queen Anne, before which Spanish, Barb, and even Arab, horses had for 100 years been introducing into England.

If, then, the Arab blood be the only true one, there is no such thing as a thorough-bred English horse. Our race-horse, with all its perfection, is, in fact, a factitious breed. That it is mostly derived from the Arab, however, will probably be inferred from its corresponding with it very perfectly in colour. With the Arab, the prevailing colours in the order of their frequency are, grey, bay, and chestnut. It is never sorrel, roan, or piebald, and very rarely black, and such also is the case with the English blood-horse.

The superior speed of the English racer over the Arab has been frequently determined, as might well be expected from an animal on an average by two hands higher, with every racing point at least equal. In 1814 a second-rate English horse, Sir Solomon, ran a race of two miles on the course of Madras against an Arab, which, giving heavy weights, had beaten every other Arab in India. This was the Cole

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Arabian, afterwards brought to England. He was under fourteen hands high, and received a stone weight. The English horse, an ill-tempered one, ran sulkily during the first part of the race, and there was every appearance that he would be distanced, but in time he ran kindly, overtook the Arab, and beat him handsomely. His success was followed by the acclamations of thousands of Natives who were assembled on the course. This statement I had from an eye-witness. In 1828, the English horse Recruit beat easily the Arab Pyramus, the best at the time in India, giving him two stone nine pounds. The distance, run on the race-course of Calcutta, was two miles.

A few years ago a match was run between an English blood-mare and the best Arab in Egypt. The race was ten miles long over the Desert. For the first mile the horses went neck and neck, after which the mare ran a-head, and before the race was over, the Arab was left behind and out of sight. In fact, the difference in speed between the English racer and the Arab is something like that between the hare and the antelope.

The European cavalry horse of the Middle Ages was of necessity a powerful animal, since he had not only to carry a rider covered with armour, but had armour of his own to bear. The same kind of horse seems to have been continued even down to the Revolution, as we see it represented in the equestrian statues of Charles the First and William the Third. Sir Walter Scott, in his "Crusaders," gives a very graphical account of the war-horse of the Middle Ages, as contrasted with the Arab, in his imaginary duel between Cœur de Lion and Saladin in the Desert. Sir Walter, by the way, was himself a cavalry officer, having attained the rank of full major in the East Lothian Yeomanry. Gibbon, I may here add, was also a military man after a way—a major of militia—to judge by the accounts we have of his person, probably not a very active one on parade, and he was never tried anywhere else. He informs us himself, however, that his training as a militiaman contributed largely towards enabling him to write "The Decline and Fall of the Roman Empire."

With such horses as I have now described, the style of horsemanship, and the kind of exercises in vogue towards the end of the seventeenth century, may be judged by a passage from the "Diary of Evelyn," dated the 13th of December, 1685. "I went," says he, "with Lord Cornwallis to see the young gallants do their exercise, M. Faubert having newly railed in a *manège*, and fitted it for the academy. There were the Dukes of Norfolk and Northumberland, Lord Newburgh, and a nephew of Duras, Earl of Feversham. The exercises were,—1st. Running at the ring. 2nd. Flinging a javeline at a Moor's head. 3rd. Discharging a pistol at a mark. Lastly. Taking up a gauntlet with the point of a sword;—all these performed in full speed. The Duke of Northumberland hardly missed of succeeding in every one,—a dozen times, as I think. The Duke of Norfolk did exceeding bravely. Lord Newburgh and Duras seemed nothing so dexterous. There I saw the difference of what the French call *belle homme à cheval* and *bon homme à cheval*, the Duke of Norfolk being the first, that is, a fine person on a horse, the Duke of Northumberland being both in perfection, namely, a graceful person and

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excellent rider. But the Duke of Norfolk told me he had not been at this exercise for these twelve years before. There were in the field the Prince of Denmark and the Lord Lansdowne, son of the Earl of Bath, who had been made a Count of the Empire last summer for his service before Vienna."

The Arabs occupied Spain for seven centuries, and the African shore of the Mediterranean they have possessed for twelve, and from the intermixture of the blood of their horses with that of the native races has been derived the jennet and the barb. A good native horse, however, probably existed in both countries, and indeed with respect to Barbary it may be considered certain, when we know that the Numidian horse formed the best cavalry of Hannibál, and contributed largely to his victories over the Romans. The Persian horse is said to have some Arab blood, but it cannot be large, for the modern horse does not materially differ from that represented with great spirit and seeming truth in a celebrated mosaic pavement of Pompeii, which is, at least, by seven centuries older than the conquest of Persia by the Arabians. The horses of the mosaic are, in fact, very ordinary animals, without the smallest show of blood, and so is the modern Persian horse.

But, besides those already named, there are horses in various parts of Asia which seem to be endemic in the countries in which they are found, and to have received no admixture of foreign blood. Such a race is the squab, strong, and sure-footed little horse of Butan, called the Tangan, frequently imported into Bengal. The small horse of Thibet is another instance. Like the shawl-goat, and all the other animals of the elevated and dry region which it inhabits, it has a double coat of hair, a long shaggy outer one, and at the roots of this a fine woolly one corresponding with that which in the goat is the material of the Cashmere shawl.

The horses of the plain of Hindustan are of ample height and considerable activity, but wanting in strength, and above all in bottom, and very often vicious. It is remarkable that the best breeds are found towards the south, and especially in Central India, and the worst towards the East, including Bengal and Orissa. As no remarkable care in breeding is anywhere bestowed by the Indians, the superiority of the horses of such countries as Mysore, Cattewar, Gujrat, and Malwa, may be attributable to a peculiar suitableness of soil and climate, and probably to the introduction, in remote times, of some portion of Arabian blood. In general, the Indian horse is what the Irish, and sometimes the Scots, call a *garron*, that is, a vulgar hack. At all events his inferiority is declared by the necessity we are ourselves under of going to the Persian and Arabian gulfs, to the Cape, and to Australia, for a better. One flagrant misnomer which Europeans apply to the common Indian horse may be noticed. He is usually known to them under the appellation of *tazi*, meaning jade, and almost "screw," whereas the word, which is Arabic, properly signifies a true Arab.

Proceeding south, we have the Burmese or Pegu pony, and among the Islands of the Indian Archipelago, from Sumatra to Timur, a great variety of races, for every island possessing the horse has, at least, one race, and the larger several. Among these the most remarkable is the horse of a certain volcanic island called Sumbawa, and more especially

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of a district of it called Gunung Api, which literally signifies "fire mountain," or, in other words, "the volcano." The Sumbawa horse is generally below twelve hands, and its most frequent colours grey and bay, occasionally sorrel, but, as with the Arab, rarely black, and never piebald. It has the legs and the blood-head of the Arab, its spirit, bottom, good temper, and, proportioned to size, more than its strength. Of these I remember that the late Sir Stamford Raffles presented a set of four to the Princess Charlotte, which she drove in Windsor Park. With relays of these insular ponies, I have myself, as did many others of my contemporaries, ridden 100 miles on end, at the average rate of ten miles an hour. The weight carried was full thirteen stone.

The most current name for the horse of the Indian Archipelago is the corruption of a Sanscrit one, and from this circumstance it might at first sight be supposed that the animal was introduced from India. For this, however, there is no foundation, for the Indian name is but a synonym, for, in the language of Java, where the horse is most numerous and which is the chief seat of Hinduism, the current name is a native one. In one of the principal languages of the great island of Celebes, the horse bears the Javanese name, while in another it is known by the odd one of the "buffalo of Java." In Celebes, which contains extensive grassy plains, and no tigers, the horse is found in the wild state, and he is hunted with the lasso and reclaimed as in America. From these facts, we may be disposed to infer that the Javanese, long a civilized people, taught the people of Celebes—a very rude one, even when first they became known to Europeans—the art of domesticating the horse. It may be added, in corroboration of this view, that the horse of Celebes differs materially from that of Java, being larger, stronger, and better bred.

Proceeding eastward and southward, the horse is found, for the last time, in Timur and Sandalwood Island, each of which has a race peculiar to itself. In no island of the North or South Pacific Ocean was the horse found. Going northward, after quitting Borneo and Celebes, we find a native horse, for the first time, in the Japanese Archipelago. This would seem to be a peculiar race, if the horse of Japan was not imported from the rude countries on the Gulf of Okotsk, which, considering the state of the Japanese navigation, is not very probable. Here we have no longer the mere ponies of the Indian Archipelago, but the full-sized horse, which old John Adams, a mariner, born and bred in Wapping, and a mighty favourite of the Emperor of Japan of his day, writing from the spot in 1613, thus describes:—"Their horses are not tall, but of the size of our middling nags, short and well trussed, small headed, and very full of mettle, in my opinion far exceeding the Spanish jennet." My friend Mr. Oliphant, in his interesting narrative of Lord Elgin's Mission, confirms this statement, and gives the following curious account of the *manège* of a people as numerous as ourselves, and of whom, for 250 years, we have known nothing but their lacquer-ware and curious porcelain:—"As Lord Elgin had not yet seen much of the town, I accompanied him on shore on another tour of exploration. In the course of our walk we came to a large enclosure, and on entering it found fifteen or twenty men on horseback, galloping and curveting about a considerable area, apparently used as a riding school. This, we understood, was the constant

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afternoon amusement of the 'young bloods' of Nagasaki. They were all men of fortune and family, princes and nobles of the land, and this was their Rotten-row. They rode fiery little steeds, averaging about fourteen hands in height, and took a delight in riding full gallop, and pulling up short, after the favourite manner of Arabs. The saddles were constructed on the same principle as they are in China, but with less padding. The stirrup-leathers were short, and the stirrups like huge slippers, made of lacquer. The bit was powerful, and the reins made of muslin, but strong notwithstanding. When we appeared two or three good-looking young men pulled up near us, and most good-naturedly pressed them upon us. I took a short, uncomfortable gallop upon one with a propensity to kick, and was glad soon to relinquish him to his smiling owner. We were much struck with the gentlemanlike and unconstrained bearing of these young men, who evidently wished to show us all the civility in their power."

From all the facts now detailed, the great probability seems to be, that in many countries there existed distinct races of the wild horse, which, in due time, their respective inhabitants reduced to servitude. Scattered over the greater part of the Old World, and consisting of widely-different varieties, and considering the extremely rude state of the intercourse, and more especially of maritime intercourse, of the early nations, most of whom were even ignorant of each other's existence, it is difficult even to imagine that all the horses of the world were derived from one single stock. Neither the Hindus or Arabs had carried their horses to the islands of the Malay Archipelago, although they communicated to them their religions and a very considerable portion of their languages. The Malays and Javanese did not succeed in conveying their horses to the islands of the Pacific, although they did a considerable portion of their languages. Close to them was the Philippine group, and to the inhabitants of this they communicated a considerable portion of their languages, and even a smack of their religion; but it remained to the Spaniards to bestow the horse upon them. The large and fertile island of Formosa is but eighty miles distant from the populous coast of China, but the Chinese had never occupied it until Europeans showed them the way to it only two centuries ago. They have ever since then occupied it, colonized it, and drawn large resources from it, but down to this day have not introduced the horse.

Attempts have been often made to trace the first domestication of the horse to a particular country, but the inquiry seems to me an idle and unnecessary one. Wherever the horse existed in its wild state, it would very easily be domesticated, and, consequently, in many different and independent localities. It was not found domesticated in America, or Australia, or the Isles of the Pacific Ocean, because in these parts of the world it did not exist in the wild state, and, in a rude state of society, it could not possibly have been conveyed to them from countries in which it was indigenous. The case was different with the dog: it existed, most probably, in all the countries in question in the wild state, and was consequently found in the domesticated state in all of them.

The era of the first domestication of the horse must have been very remote indeed, for it required but a very small amount of civilization in

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the men who achieved it. This is sufficiently proved by the fact that some of the rude tribes of America had, within fifty years of the discovery of the New World, domesticated the horse, already become wild,—and that they have ever since continued to make use of it; and, by so doing, have been able to maintain a rude independence, assuming, in some degree, the nomadic habits of Arabs and Tartars.

The domestic, but not the wild or the feral horse, is a frequent subject of representation on the monuments of Egypt, estimated to be of an antiquity of some forty centuries; but this is very far from carrying us back to the first domestication of the horse, for when the Egyptian sculptures and paintings were executed, the Egyptians were in possession of many of the useful arts, and had even invented letters,—were, in fact, an ancient civilized people—and, for aught we know to the contrary, the horse may have been domesticated in Egypt four thousand years before the time in which it was represented on its monuments. If this reasoning be valid, the probability is that the horse was domesticated just as early in other parts of the Old World, from the British islands to Japan, as it was in Egypt.

The first use to which the horse would be put must have depended on the characters of the people and country in which it was domesticated. Riding must have been the first use to which it was put, for it is not easy to suppose that it would have been tamed and broken in without having been mounted. The purposes to which it would be used would be war, travel, and pleasure. It is only in very advanced periods of society that it is applied to agricultural and other useful labours. In this it is anticipated or superseded by the ox in most countries, and by the ox in conjunction with the buffalo in others. It is only in very advanced periods of society that it is used for draught, and this chiefly in modern Europe—a matter, however, which seems to be in some measure determined by the superior size, weight, and strength of the races of this part of the world. Throughout all Asia, and indeed throughout the whole of Eastern Europe, the horse is nearly unknown for draught, either in plough or carriage, while with ourselves it has justly superseded the slow and heavy ox—clear evidence of a superior intelligence and civilization.

In the ancient monuments of Egypt, the horse is almost always seen in draught only—a pair drawing a two-wheeled chariot, with a pole, in the manner of a curricle. A pompous display would seem to have been the only object. One or two samples only occur of a man on horseback, and then sitting not astride, but sideways, without bridle or saddle, and in mere frolic. But in due time the Egyptians had a cavalry, for when the king of Egypt pursued the Israelites, after their escape from bondage, he did so with horsemen as well as with chariots, and this is supposed to have happened about 1500 years before the birth of Christ. The ancient Britons had their war chariots, while Gauls, Numidians, and other contemporaries not more advanced, had cavalry, but not chariots. Whether cavalry or chariots were used in war was probably a matter of chance. I may here remark, that the mere capacity to construct a wheel carriage, however rude, is a fact which shows that in the days of Julius Cæsar we were not such arrant savages as we have been sometimes represented. We had not only the skill to construct chariots, but even to arm them with

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iron scythes. The iron, no doubt, must have been rather scarce, for we used it at the same time as our only money, and probably valued it as highly as the Roman conquerors did silver.

So much for the origin of the horse, and I may now offer a brief comparison of his utility to man in the work of labour, as compared with that of other domesticated animals, a fuller account of which must, however, be delayed for another opportunity. The camel, unsuited for draught, is the beast of burden of the desert and of dry lands. It is wholly unfit for wet soils, and for countries with periodical rains: in the mud it slips, flounders, falls, and, lacerating the ligaments of the hip-joint, never rises. It is, perhaps, the only quadruped that cannot swim. In a civilized country, with good roads, it would not be maintained at all, and it must be pronounced to be the beast of burden of the barbarian only. So delicate is its constitution that in the Affghan wars it has been estimated that 50,000 of them perished.

The services of the elephant are, at the utmost, limited geographically to some thirty degrees from the equator, and are indeed unknown, except in India and the countries between it and China. Even in India the cold is so little congenial to it, that it is only by degrees it can be moved northwards with safety. Although preferring the plain, the elephant climbs hills and precipices with a success little to be looked for from its huge bulk and unwieldy form.

Yet, although the native of a warm climate, Hannibal succeeded in taking a number across the Alps, a fact which may lead us to suspect that his passage was an enterprise less arduous than is generally imagined. Of the number of thirty-seven which he brought into Italy, one only, however, survived the first battle, for even in the plain a heavy fall of snow had taken place which destroyed them. But the elephant, although a floundering and awkward swimmer, is a bold one, and swims across the Ganges and the Jumna without difficulty. One is therefore surprised to find the difficulty which Hannibal encountered in transporting them over so comparatively small a stream as the Rhone. The elephants, however, were African, a distinct species from the Asiatic, and the natives of a higher latitude and a drier country than the inter-tropical parts of India and its neighbourhood, the country of the Asiatic elephant; and this may possibly account for their antipathy to the water, and their capacity to sustain a degree of cold which enabled them to be taken across the Alps—implying a cold under which the elephants of Chittagong, Burma, Siam, and Ceylon would have quickly perished.

The elephant, naturally a timid and cautious animal, never could have been of much service in war: had it possessed courage equal to its bulk and strength, it would, of course, have trodden down whole battalions. But it is formidable only to the eye, while it is itself a huge target to be shot at. To ride it for any distance is, at least, a very severe exercise, for, although it has no other pace than a walk, the jolting of that walk is equal to that of a carriage without springs, on what the Americans call "a corduroy road." I have never heard of the elephant being employed for draught except in Ceylon, where one is yolked to a huge car for hauling materials for the construction of roads and other public works. In towns, and on frequented highways, the elephant, from his unwieldy size

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and uncouth form, becomes a public nuisance, and it may safely be anticipated that, with good roads, its use will eventually be discontinued.

The horse is the universal hero of labour, suited for all kinds of work, and for their performance in every climate. His almost exclusive employment in labour is in itself evidence of a high civilization. With ourselves, by careful breeding, we have been able to produce races adapted to every assignable purpose—some that can draw three times as much as the elephant can carry, and some that are fleeter than the antelope. He is the only animal that enters the field of battle with us. He even partakes of "the rapture of the strife," and without him no great decisive battle could be fought, or, in fact, ever has been fought. "The glory of his nostrils is terrible. He paweth in the valley and rejoiceth in his strength. He hurries on to meet the armed men,—he mocketh at fear,—he turneth not his back from the sword. The quiver rattleth against him—the glittering spear and the shield. He swalloweth the ground with fierceness and rage; neither believeth he that it is the sound of the trumpet calling a retreat. He saith among the trumpets, On—on! and he smelleth the battle afar off, and heareth the thunder of the captains and the shouting." That passage, as you all know, is taken from the Book of Job. I cannot help thinking that the animal so well described in it, with glory in his nostril, and pawing with impatience for the charge, must have been no other than a true Arab. In fact, the scene of the Book of Job is laid in Edom or Idumea, which is now, and always has been, a portion of Arabia, although in contact with Syria. The patriarch was in reality a powerful Arab sheik, or independent prince, in possession of sheep, camels, and asses, by thousands; and the mention of the sword, and the "glittering spear," implying a knowledge of malleable iron, shows that his subjects were by no means such barbarians as were the Mexicans and Peruvians when first seen by Europeans. In the enumeration of the Patriarch's stock, it will be seen that horses are not named. Most probably they were rare at the time, and the luxury of the chieftains, and would no more be named than their wardrobe or jewelry and trinkets.

You will have observed, that, in the passage I have quoted from the Book of Job, I have omitted that part of the description of the horse which makes his neck to be "clothed in thunder." It is now considered to be a mistranslation, for it appears that the same word signifies in the Hebrew "thunder" and a "horse's mane." The translation ought to have been "flowing mane." The interjection, "Ha! ha!" too, appears to be a mistake, for that simply expresses wonder or surprise, which is by no means consonant with the feeling attributed to the horse at the moment of action. It ought to have been, "let us advance," or, "let us go on." These corrections of our version we owe to M. Ernest Renan, a distinguished French Orientalist, to whose translation of the Book of Job my attention was directed by my learned and accomplished friend the Dean of St. Paul's.

A comparison of the powers, for labour, of the different animals which man has employed to assist him, is not only a subject of rational curiosity, but one that throws a broad light on the condition and progress of society. These are the dog, the ox, the buffalo, the horse, the ass, the elephant, and the llama.

According to Captain Lyon, quoted by Sir John Richardson, an Esqui-

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maux dog will draw in a sledge a load of 160 pounds, going at the rate of a mile in nine minutes, or near seven miles an hour. An English dray-horse will easily draw a ton on a good road, going however at not more than the rate of three miles an hour. In this case, the draught power of the horse is equal to that of fourteen dogs, while the pace of the dog is nearly seven times that of the horse; but the dog must have ice or frozen snow to travel over. On an ordinary road, he would probably be over-draughted with a load of twenty-five pounds, while his speed would hardly equal that of the horse. In this case it would take ninety dogs to equal one horse, and the cost of keeping them would be as great as that of keeping four packs of fox-hounds.

In India it has been ascertained that the average burden of an ass is 100 lbs.; of a bullock or mule, 200 lbs.; of a camel, 400 lbs.; and of an elephant, 800 lbs. One elephant, then, is equal to two camels, to four bullocks or mules, and to eight asses. The respective merits of these animals as beasts of burthen cannot however be measured by their mere capacity for bearing a load. The first cost of the elephant, for example, is ten times that of a camel, and his keep costs as much as that of eight camels. This is indeed, in some measure, compensated by the better constitution and higher longevity of the elephant, whose length of life is full ten times that of the camel—equal, indeed, to that of man himself; that is, three score and ten, or even four score. Had his life, I may add, been proportioned to his bulk, it ought to have been a great deal longer, for it has been ascertained that the average weight of an Indian elephant is equal to that of twenty-four men, each of ten stone, or to a subaltern and his whole section of light infantry.

In Thibet, but there only, a variety of large sheep is used as a beast of burden, although it might well be supposed that its own immense double fleece would be an all-sufficient load for it. In the New World there is but one beast of burden, the llama, a diminutive species of camel, by the structure of his foot and by his constitution fit only for mountain regions. His average load is sixty-five pounds. One camel of the Old World, then, is equal to six of the New. It will appear, from the facts now stated, that an English dray-horse, on a good road, will draw the united burdens of two elephants, one camel, and five oxen. His power of transport is superior to that of five of the best camels that Arabia ever produced, and to that of thirty-four of the camels of the New World.

For riding, the superiority of the horse is equally great. The elephant, his only pace, walking, will travel at the rate of four miles an hour, but it would distress him greatly to continue it for twenty miles. It would take him five hours to perform this journey, which the horse would perform in one hour. Of the domestic animals, the dromedary, or common camel, is the one that in speed approaches the nearest to the horse, and its pace is probably equal to about one-half that of the horse. The messenger camel will travel, it is said, one hundred miles in twenty-four hours; but an English blood-horse has been known to perform a journey of double that distance within the same time. But in the case of the camel, the pace is "a killing" one; not to the animal, but to the man; for it is said that the life of the professional camel-rider, the Shuter Suwar of the Persians, does not exceed five years' duration.

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But the horse has been at length surpassed, although by no means superseded—indeed, in no degree even displaced, for it has increased in number—by a new power. A few years ago, a meritorious operative, a heaven-born engineer, invented, almost created, a machine, which in speed eclipses Eclipse, and leaves Flying Childers "nowhere,"—which can draw with ease the load of a thousand, or, if need were, of ten thousand elephants, and which, in one-fourth part of the time, without fatigue to itself or to the rider, can perform the feat which saved Turpin's neck by proving an *alibi*. That machine is now at work in the native country of the slow camel and slow and ponderous elephant, a creditable tribute to George Stephenson and the nineteenth century. The son of this man of genius, almost the equal of his father, was lately laid in the spot which Nelson thought was equivalent to a dukedom. Perhaps you will be of opinion that the remains of the father ought in justice to repose alongside those of the son!

I have now but a few words to add, on the supply of the English breed of horses for cavalry purposes. The English horse, like the Englishman himself, is a thorough mongrel, and as the horse has, beyond all question, improved by crossing, we may safely conclude that the being has suffered no detriment by it, that has produced a Shakespeare and a Milton, a Chatham and a Burke, a Watt and a Stephenson, a Marlborough and a Wellington, a Blake and a Nelson, and which will assuredly produce their equals whenever their country shall have need of their service.

We, who formerly imported all our best horses, are now the only people who export good ones, and we supply all nations that have sense and ability to buy. I have looked at our export of horses for the last year for which the public accounts are made up, and find the number exported to have been 1,574, and their custom-house value to have been £117,422. France had out of these 755, and Belgium and Germany 611. I suspect that the officers of Her Majesty's Customs are not good judges of the value of a horse, for the valuation of those furnished to France was short of £50,000, or at the average of £66 a head, which is much too low a valuation, for I have every reason to believe that one of the horses exported was the "Flying Dutchman" (of whom it never could be said that, like his namesake, "he was nowhere"), which was sold to the French for the sum of £5,000. It is certain that we have turned the tables on the French since the time of Charles II., when a Frenchman was the master of his Majesty's riding-school, and pronounced by old Evelyn to be the first judge of a horse in Europe.

Wherever the Anglo-Saxon race has settled, the improved English horse has been introduced, and, wherever climate and pasture have been favourable, with success. India, which has most need of the cavalry horse, is not one in which the introduction of the English horse has been most successful. A great stud has existed in Bengal for sixty years, without ever having been equal to furnish even a sufficient supply for the European cavalry of that government. The stud of Madras, situated on the table-land of Mysore, is upon a far more rational and economical scale than that of Bengal, consisting only of Arab sires. The grasses of India are neither abundant nor nutritious; the plain proof of which is, that the flesh of no mere grass-fed animal is fit for the table, that of the

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stall-fed animals alone being so. But, even were the conditions more favourable for breeding than they are in India, studs are not among the establishments which it is within the legitimate province of any government to maintain.

After the United States of America, which in breeding the English horse stands next to England itself, the most eminent success has attended its rearing in the Cape of Good Hope and Australia. The Cape farmer, who used to drive his produce to market at a snail's pace, with a team of sixteen oxen, now does it at a smart trot, with eight English-bred horses —a royal team; in all likelihood, better cattle than those which conveyed Charles II in state (some lovely Thaïs by his side) from Whitehall to the City. The success has been still greater in Australia, where the pastures are more spacious and the grasses more nutritious. In the course of the year 1858, the Australian colonies furnished for the Indian Cavalry 2,563 horses, at the average price, on the spot, of 30*l.* a head, and, when landed in India, at from 80*l.* to 90*l.*; being a smaller price for a better horse than that supplied by the Government stud.

Here, then, we find a country which, seventy years ago, had not only no horse, but no native animal more respectable than a kangaroo, the brain of which, the great naturalist Mr. Owen tells us, is of no higher order than that of a reptile, exporting more horses than England itself, and adding their value to five millions' worth of sheep's wool and twelve millions' worth of gold. Two generations ago its population consisted of a few savages, the very lowest in the scale of humanity, and now its inhabitants are Anglo-Saxons, amounting to near a million. A century hence, this continent of the Antipodes will contain more people than the United Kingdom now does; and, unless they differ greatly from their progenitors, they will be meditating the conquest of the whole Indian and Philippine archipelagos, giving law to China and Japan, and quarrelling with New Zealand—by this time as crowded with ambitious Anglo-Saxons as itself.

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Friday, February 24th, 1860.

Major-General Sir R. J. DACRES, R.A. K.C.B., in the Chair.

THE CAMPAIGN OF MARENGO.

By Lt.-Col. E. HAMLEY, R.A., Staff College, Sandhurst.

WEIGHTED with all the cares of revolutionary France—suppressing factions, restoring public credit, forming an administration, developing the internal resources of the land, controlling the movements of her armies, and negociating with the powers of Europe—it was amid such occupations that Napoleon, at thirty-one, after a few months' experience of almost absolute rule, prepared to illustrate the unsuspected resources of strategy by a novel and startling application of its principles in the campaign of Marengo.

Although in his first Italian campaign his genius for war had at once appeared fully developed—though he sprang on the theatre of the world, as Pallas on that of Olympus, armed at all points—yet he was then wielding materials which he had no share in creating; he was directing an army and a system formed by the necessities of the French Republic, of which he was himself only an instrument. Now, as First Consul, he was responsible to his own inspirations alone; but his short tenure of power had afforded him no opportunity to remodel the system, and he had to make the best of it as it lay ready to his hand. It was not till the days of the Empire that he was enabled to execute his vast designs with instruments formed and chosen by himself; when the world beheld the extraordinary spectacle of a great country bending all its resources, its wealth, its men, and its materials, to the purposes of war, at the direction of the greatest military genius in existence.

While Napoleon had been in Egypt, lured thither by his dream of Eastern dominion, all the ground won in Italy by his brilliant campaign of 1796 had been recovered by the Austrians. In the beginning of May, 1800, the only French troops remaining in Sardinia were the garrison of Genoa under Massena, who were blockaded by 25,000 Austrians, under General Ott on the land side, and by Lord Keith's squadron on the coast. Suchet, with the remainder of the French army of Italy, had been driven struggling out of the Apennines into Provence, and was now holding the frontier line of the Var with 14,000 men against treble their numbers. On his left, General Thurreau with 4,000 men occupied, on the French side of the Alps, the pass of Mont Cenis, opposite Turin. These were all the French troops in presence of the enemy. The Austrians, besides their corps before Genoa and on the Var, held the fortresses south of the Po with considerable garrisons, and had posted detachments opposite every pass of the Alps, from the St. Gothard to Pignerolo. Their forces in

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Sardinia, numbering something more than 100,000, were thus extended on a line, from Nice to Bellinzona, of more than two hundred miles.

This faulty extension of the Austrians promised, to a general who should either adequately reinforce Suchet on the Var against their left, or advance by Mont Cenis against their centre, a favourable opportunity for arresting the tide of success, by throwing back a portion of the enemy's line before its dispersed fractions could combine. But France possessed no apparent means of doing this, for her only army was on the Rhine, under Moreau. Yet the idea which had taken possession of Napoleon's mind was no less than to attempt, not the repulse, but the destruction of the Austrian army of Italy, and, moreover, to accomplish it in time to save the garrison of Genoa.

The first thing necessary was troops. In the form of depôts, reserves of regiments, conscripts, and skeleton-corps exhausted by former campaigns, there existed, in various parts of France, sufficient numbers of soldiers to form, along with the brigades set free by the pacification of La Vendée, an army of 40,000 men. But to assemble these openly would be to place Austria on her guard and render them of no avail. Profound secrecy was therefore an essential condition of even the promise of success; and it was essential also to select for the assemblement a place near the intended point of operation.

North Italy is divided naturally into three portions, called by strategists zones. The lowermost, or Napoleon's right, lies between the sea and the Apennines, the centre between the Apennines and Po, the left between the Po and the Swiss Alps. Each of these portions is isolated from the rest by natural obstacles, and may, therefore, include all the chief operations of a campaign, and the advantages of selecting either of them might thus be weighed separately. The limited space between the Apennines and the sea was favourable to the force numerically inferior to the enemy, as Napoleon's must be; moreover, in that mountainous region the superiority of the Austrians in cavalry and artillery was rendered nugatory, while the foot-soldiers of the Republic, who had always maintained their pre-eminence, would fight on the ground most favourable to the exercise of their activity and intelligence. But successes here must be slow; the Austrians would constantly, when pushed back, be reinforced through the passes of the Apennines; and in retiring they would still cover the siege of Genoa. If beaten, however signal their defeat, they would be driven along their proper line of retreat to the shelter of their great fortresses in Lombardy. Decisive success then was not to be hoped for here, and nothing short of absolute triumph would satisfy the aspirations of Napoleon.

In the space between the Apennines and Po, three fortresses, those of Turin, Coni, and Alessandria, existed, each a stumbling-block in the path of an advancing army. This, too, was the centre of the Austrian line; and the centre of a line can manifestly be reinforced by the other portions more easily than either extremity. The fortresses would afford the separated corps time to reassemble; by holding the passes of the Apennines they would prevent Suchet from relieving Genoa, and, if defeated, they would still, in falling back, cover the siege, and would, as in the former case, retire on their proper line of retreat. Neither, then, was a great and swift success to be hoped for here.

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In the remaining zone, the space between Switzerland and the Po, the Austrians, besides being numerically weakest, were most widely extended. This then was the weak point of their line, for no fortresses existed on it; but it was also the most difficult of attainment, sheltered as it was by the Alps, the rugged passes of which seemed to forbid the passage of an army. But the Austrian line of retreat, owing to the geographical features of North Italy, obliqued from the Austrian centre and left across their right rear. If the right could be forced or turned, Napoleon would place himself across that line of retreat, and force them to a battle, in which a simple repulse would be for them annihilation. Here, then, lay the condition of success, the garden of the Hesperides, but guarded by a line of enemies, whom a whisper of his design would increase to a host, and by an external barrier of mountain and snow which seemed insurmountable. But it was a characteristic of Napoleon to disregard all paths, except the pre-eminently decisive one: moderate successes, which would have constituted the glory even of great men, could not divert him from his higher aim; and having once detected, as he always did, the point where the greatest result lay, he thought, henceforth, only of overcoming the intervening obstacles. All or nothing was the condition on which he played his tremendous game; so many chances did his genius accumulate in his favour, that if he should not win he was still secure against heavy loss; but with the additional chances which fortune, in those earlier days, delighted to bring to him, he always won.

He looked round then to calculate his means for the achievement; if to all appearance insufficient, nevertheless a powerful genius, urged by a powerful will, must make them suffice. All the troops he could assemble in France to form the so-called army of reserve, 40,000 strong, were still too few for his purpose. But Moreau was preparing to cross the Rhine with 180,000 men to attack Kray; if Moreau should be successful, he could spare a reinforcement for Italy; and that he might be successful, Napoleon suggested for him a plan of campaign at once audacious and prudent, which, executed by its contriver, would have been immediately and signally decisive. But the genius of Moreau differed from the genius of Bonaparte; of a cold and prudent resolution, no enthusiasm nor heroic greediness of glory excited him to risk a hazardous throw. He, too, had his plan, in the excellence of which he put his faith—less brilliant, more cautious, and apparently, though not really, more prudent; and Napoleon's sagacity leading him to recognise the truth, that, where so much depends on execution as in war, a plan should be executed by him who conceives it, he relinquished his own design, and Moreau was left to the development of his cherished idea.

Over the St. Gothard and the Simplon, the two St. Bernards and Mont Cenis, there were, in those days, no roads, but only rugged paths, where mules toiled upward, and slid and scrambled downward, in single file. Switzerland had been for two years occupied by the French, and all these passes were therefore available. The St. Gothard was reserved for Moncey, who was to bring the corps from the Rhine—it remained to choose the point for the passage of the army of reserve. That point must be such as to combine the advantages of affording the greatest facility to the real design, and giving a false impression to the enemy. The design

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was to unite with Moncey at Milan, and from thence to cross the Po. Napoleon was resolute to grasp the whole Austrian army, by interposing between it and its great fortresses behind the Mincio. Ott's corps besieging Genoa would, if compelled to fall back by the approach of the French, retire across the Po at Piacenza; Napoleon must therefore interpose not higher up the stream than Piacenza, or Ott's, and perhaps other corps, would elude his grasp. Milan, then, was his aim, as being the nearest point to Piacenza where he could unite with Moncey; but, while directing his march thither, he must conceal it as long as possible from the Austrian commander, who might otherwise anticipate him by the right bank at Piacenza, or intercept his own communications with France. Now the St. Bernard pass leads upon Ivrea, where the road branches—one branch goes to Milan, one to Turin. This fact, insignificant perhaps to the uninstructed eye, decided the line of march of the army. Once arrived at Ivrea, the advanced guard should move towards Turin, while, behind the screen of its extended front, and covered by the Po, the army should advance on Milan.

This plan had been matured some time before it was put in operation; and during April the troops were moving on the point of assemblement. That point was Lausanne, one march from the foot of the St. Bernard. But that point, as before said, must be carefully concealed, and Napoleon diverted attention from it with the careful craft which formed one element both of his character and of his success, and which seemed to partake both of littleness and greatness—little in its dissimulation, great in its sustained energy and its contribution to a grand result. He gave out, with great ostentation, that there was to be an Army of Reserve, and that it was to assemble at Dijon, for he thought it far safer to give the spies a wrong direction, than to attempt altogether to hide the traces of his design. Dijon might be supposed to be a convenient place from whence to reinforce the army of the Rhine; it was therefore declared by messages to the legislative body and the senate, by decrees, by publication in the newspapers, and by intimations of all kinds, that the point of concentration of the army of reserve was Dijon. Thither flocked the spies and scouts, who beheld there, in the beginning of April, a staff without an army, and in the course of the month a body of a few thousand conscripts and retired soldiers, many of them maimed, whom Napoleon ostentatiously reviewed. Then the sagacious spies, concluding that they had seen through the transparent deceit of the First Consul, published, in all directions, their discovery of the fact, that the Army of Reserve was a phantom. It was believed in Vienna, in London, even in Paris ; Europe was filled with derision at the absurdity, and its capitals exhibited everywhere caricatures on the subject, one of which represented a small boy, and an invalid with a wooden leg, under which was written " Bonaparte's Army of Reserve." Enemies and spectators enjoyed the joke, while through France were marching, by devious routes, converging on the destined point, the men who were to win Italy at Marengo. Passing in small bodies, they attracted no attention; and, as their destitution was extreme, they found at one town shoes awaiting them, at another coats, at a third new muskets, but at no one place stores of sufficient magnitude to excite suspicion. These arrangements all resulted from the forethought of the First Consul,

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whose irrepressible energy forced itself into the minutest details of the project.

The army assembled at Lausanne unsuspected. The guns, with their equipments, came from the arsenals of Auxonne and Besançon, where they were supposed to be prepared for the army of the Rhine. Berthier was the nominal commander, though all the orders issued from Napoleon, who arrived on the 13th of May, and received the report of General Marescot, an engineer, who had been dispatched to reconnoitre the passes. He was impressed with the grandeur of those tremendous solitudes, and talked of the glaciers and avalanches; but Napoleon, intent upon one thought, asked him but one question, "Is it practicable?" "Yes," was the answer, "but with extreme difficulty." "Let us start, then," said the First Consul. He had that day been notified that Moncey, detached with 15,000 men from the army of the Rhine, was moving through Switzerland towards the St. Gothard. The troops had ample supplies. In the departments of the Rhone, two million rations of biscuit had been made, two hundred thousand of which had, with much parade, been forwarded to Toulon for the garrison of Genoa, whilst the remainder was secretly conveyed up the Rhone to Geneva. Each soldier carried six days' rations; corn, oats, and brandy in immense quantities had been collected between Geneva and the foot of the Alps, whither live cattle in sufficient numbers had also been driven. No cause of delay remained, and the army begun its march at once in a succession of divisions, the advanced guard being under Lannes, afterwards one of the most famous marshals of the Empire, and always foremost in battle, till a cannon-shot shattered him at Essling; while the rear-guard was under Murat, the *beau sabreur* and future king.

All was clear as far as St. Pierre, a village at the foot of the Alps; but there the grand difficulty of the enterprise began. There commenced the narrow path that winds like a thread over the St. Bernard, up which horses could only pass in single file, led by their riders, and where artillery consequently could not pass at all. But forty thousand men would be of no avail in Italy without guns, and the transport of these had been provided for. Half a company of artificers posted at St. Pierre took the carriages to pieces, which were packed on mules, while the guns were placed in trunks of trees hollowed to fit them, with grooves to receive the trunnions, and were drawn each by a hundred soldiers. Lannes, with his vanguard, passed on the night between the 14th and 15th. Then the silence of those desolate ravines, unbroken for centuries except by a solitary group of travellers and guides, was invaded by the clangour of arms and the tramp of a multitude. Upwards they filed in long array; the foot-soldier laden with his weapons, his biscuit, and his ammunition, a weary load; the horseman drawing after him his stumbling steed; and the tree-trunks, containing the guns, each of which tasked at every turn the strength and dexterity of its hundred men. But the troops were filled with the enthusiasm and ardour for glory generated by the nobler elements of the Revolution. These mountains, with their robes of snow, must be passed before they could conquer Italy under their redoubted general—and the song and talk passed onward up the steep, uninterrupted, except where some yawning crevasse opening in the path threatened destruction, or where an avalanche, loosened by the sun

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of May, filled the crags and valleys with the reverberations of its fall. At the summit a surprise awaited them. The First Consul had despatched to the hospitable monks of St. Bernard a considerable sum of money for the purchase of provisions, and they had fulfilled their mission by catering liberally for the army. Long tables were spread out, where every soldier found bread, cheese, and wine, and went on his perilous way rejoicing. So grateful was Napoleon for this seasonable aid, that not only did he, in passing the convent, leave a munificent sum to be devoted to the generous purposes of the establishment, but, in the following year, he built two similar hospices, one on Mont Cenis, the other on the Simplon, each containing fifteen monks, and endowed with a considerable income from the lands of the Cisalpine Republic.

By the 20th all the divisions had passed and descended the slopes of the Italian side. Many horses slipped over the precipices, or were engulfed in the yawning crevasses, but few soldiers perished. At St. Remi, a village at the foot of the St. Bernard on the Italian side, another half company of artificers, who had passed with the advanced guard, were waiting to remount the guns. Lastly, on the 20th, the First Consul, who had till now waited at Lausanne to regulate the march and supplies of the troops, crossed also, not, as represented in popular pictures, mounted on a fiery and chafing horse, with a cloak streaming in the wind, but on a mule led by a peasant-guide from the valley, and clad in the grey riding-coat which has become classic. It was time that he should cross, for an unforeseen impediment had made his presence necessary.

Lannes had twice encountered detachments of the enemy, first at Aosta, where he found some Croats whom he drove to the bottom of the valley, and, next, at the little town of Chatillon, where he defeated an Austrian battalion, taking many prisoners. The march now lay along the fertile, green, well-watered valley of Aosta, and the troops were advancing in the highest spirits, when they came upon a very lion in the path—the fort of Bard.

The officers charged with the reconnoissance of the route had been unable, of course, while the Austrian detachments barred the path, to extend their survey so far as Bard. Some Italians had represented it as the only spot where any difficulty would be likely to occur, but it had never been regarded as offering a serious impediment. It stands in a narrow portion of the valley, where all the streams of the region of the St. Bernard, uniting in the Dora Baltea, have cut for themselves a narrow channel as they rush onwards to the Po. A huge pyramidal fragment, separated apparently from the summit of one of the inclosing mountains, lies on the bank of the stream, leaving between its foot and the wall of rocks room only for the little fortified town of Bard, which besides its own proper defences is swept by the cannon of a fort constructed on a triple line of defence on the top of the conical rock, and almost unapproachable. Such was the barrier that now closed the path of Lannes. Twice he hurled his grenadiers against it, but, though he took and held the little street which constituted the town, he made no impression on the fort, which swept the street with its guns, and which only desisted from its fire out of consideration for the inhabitants. General Marescot, the engineer, summoned to the spot, declared the fort to be almost impregnable. A

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reconnoissance amid the neighbouring mountains revealed but one path over the Albaredo rock, which presented difficulties even greater than that of the St. Bernard, for it had hitherto been trodden only by goatherds and shepherds. Berthier, then commanding in the absence of Napoleon, issued orders in alarm to stop the advance of the approaching columns and material, and sent messages to apprise Napoleon of the disastrous and seemingly fatal impediment.

But the First Consul had not crossed the St. Bernard to be stopped by Bard. The fort must be taken or turned; other paths from Aosta existed, debouching lower in the valley—and he would hear of no delay. Arrived at the front, he reconnoitred the obstacle from the Albaredo mountain; saw that Bard was secure against a *coup-de-main;* and instantly ordered the cavalry and infantry of Lannes to advance by the path he had himself ascended, and which had been rendered practicable for single horses by the incessant labour of fifteen hundred men. But the guns could not cross it; neither could they again be taken to pieces and transported as they had been over the St. Bernard. The commandant of the fort of Bard, watching with mortification from his pinnacle the filing of a whole division past his post, sent word to Melas, the Austrian commander, pledging himself that not a single gun should pass. Nevertheless they did pass. An attempt to convey a gun through the street under cover of the darkness was revealed by the clatter of its progress, and stopped by the fire of the fort. But the precaution having been taken of covering the street with straw and dung, and of wrapping the pieces themselves in tow, to render their passage noiseless, the whole artillery, dragged by the gunners, passed through in the night. The investment and reduction of the fort was then left to a force of conscripts under General Chabran, who had passed by the Little St. Bernard, and it capitulated on the 1st of June.

Meanwhile Lannes, pushing on, had attacked and captured in two assaults, with his infantry, the town and citadel of Ivrea, the fortifications of which were still in the ruinous state to which Vendome had reduced them nearly a hundred years before. Reinforced by artillery from the rear, Lannes again pushed on, while the whole army assembled behind him at Ivrea.

Thus Napoleon had attained the point from whence he hoped to derive two main elements of success, which were 1st. facility of movement upon Milan, and 2dly. the means of deceiving the enemy into the belief that his object was Turin. In furtherance of this latter object, General Thurreau, crossing Mont Cenis at the same time that the main army passed the St. Bernard, served to perplex the enemy, while he also protected Napoleon's right flank. But his was not the only detachment from the main army. Two thousand Italians, branching off from Chatillon when the army passed through, advanced by Grassoney to the valley of the Sesia; a brigade of French occupying the Swiss province of the Valais, passed the Simplon under Bethencourt, moving on Domo d'Ossola; and thus the main army stretched a hand towards Moncey's force, which was coming by the St. Gothard. The latter, forming the left of the army, was secured by the successes of Moreau, who crossing the Rhine on the 1st of May had, in a succession of contests, pushed the Austrians, whose left had at first rested on the Tyrol, back upon the Danube. Thus the whole French

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force was at once concentreing and enveloping the Austrian right. It was in a condition to fight a great battle if attacked, and if defeated could retire through the passes, with the loss only of the guns: while Napoleon's strategical foresight and dexterity rendered a battle very unlikely till the moment arrived when it would suit his purpose.

On the 14th of May—while the French were at the foot of the St. Bernard preparing to commence the ascent—Melas had arrived at Nice, hoping by his superior weight to press Suchet from the Var, and to have the glory of invading the soil of France. His army was still engaged in three operations. His right and centre were watching the passes of the Alps, his left was pressing Suchet, and, in the rear, Ott pushed the siege of Genoa. The garrison, under Massena, displayed extraordinary constancy. Their sufferings from starvation were frightful; all the horses, and even dogs, cats, and rats, had long been eaten, and the troops were reduced to a horrible compound of starch and cocoa found in the warehouses of the city, while the inhabitants, denied even this wretched and revolting sustenance, maintained a feeble flicker of life by soup made of herbs. A great number of Austrian prisoners were in the place, whose sufferings rendered them dangerous. Massena placed them in hulks which were moored under his guns, and one of the most dismal features of the siege was the howling raised by these unfortunate men in the pangs of starvation. But though surrounded by sights of horror and under a pressure of daily accumulating suffering, and threatened, moreover, with the mutiny of a garrison who could no longer bear their privations, Massena never flinched, showing still a good face to the enemy, encouraging the fainting troops, and refusing to hear of surrender. Their only hope now lay in Napoleon; he was long in coming, but he surely would come at last: eagerly they looked for him, and once a storm in the Apennines brought them all, with their chief, to the ramparts, for they believed the thunder in the hills to be the cannon of Bonaparte.

A letter from Massena describing the sufferings of the garrison, and saying the place could not hold out beyond the 24th of May, being intercepted about the middle of the month, first revealed to Melas the existence of an army of reserve, which he, in common with all Europe, had hitherto entirely disbelieved. Still he thought it a force of no immediate importance, and a report that Berthier was advancing to reinforce Suchet prevented him from changing his arrangements. Any rumours which might come of the movement on his right did not disturb him—he believed it to be merely a feint to draw him from his expected successes, and he retained his grasp on them, while amid the Alps was gathering a cloud, having in its breast a bolt which was to render the doom of the army of Melas as certain as that of the hosts of Sennacherib.

At length, on the 18th, a report from Kaim, the general commanding in and about Turin, warned him of the approach of a considerable force by the Valais. He thereupon sent two divisions to reinforce the centre, by the Col di Tenda, and proceeded himself to Turin, leaving General Elsnitz with 18,000 men to oppose Suchet on the Var. The reasons for these changes were these:—If he left a force on the Po inferior to that of the French advancing from the Alps, the latter might succeed in forcing their way down the river, and cut off the retreat both of the

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corps on the Var and of that besieging Genoa. Had he known the magnitude and design of Napoleon's operations, he would have marched his whole force on the Po; but he did not yet know it, and to abandon the Var was to leave the road to Genoa open to Suchet, who would then relieve Massena. It is easy to conceive how hard it must have been for Melas to relinquish the seductive prospect of invading France at the approach of a force whose numbers he did not know, and on whose presence he had never calculated. He therefore, as most others would have done, clung to his original design to the very last.

Two things perplexed Melas when he arrived at Turin,—the advance of Thurreau by Mont Cenis, who had driven back an Austrian detachment posted at Susa, only one long march from Turin, and the capture of Ivrea by Lannes. The latter operation had been achieved without artillery; and it seemed highly improbable that the main advance would be unaccompanied by guns, especially as he knew the fort of Bard to be still uncaptured. He believed, therefore, that Lannes was the leader of a detachment, and that Thurreau commanded the advanced guard of the invading army. Thus the stoppage of the artillery at Bard, seemingly so unlucky, actually contributed to veil the design of Napoleon. Melas directed his attention towards Susa, and further reinforced the detachment there, which already greatly outnumbered Thurreau's.

But on the 26th May, Lannes, reinforced at Ivrea by a division with artillery from the rear, again advanced,—not towards the real point, Milan, for that would at once have revealed the plan, which might then have been easily disconcerted,—but towards Turin. On the road he attacked the Austrian detachment under General Haddick, at Romano, on the Chiusella, and, driving him behind the Orco, pushed on to Chivasso, where, as if to cross the river, he seized a great number of boats on the Po.

Hitherto, on the supposition that the main army was advancing by Susa, Melas dared not detach a considerable force against Lannes, because the centre thus weakened might be broken, and Napoleon might interpose between the forces north of the Po and the corps of Elsnitz and Ott. But the fact of French guns being engaged at Romano proved that the main operation was by the valley of Aosta, for wherever one gun had passed fifty might follow; and Melas now knew that Napoleon was present there in person.

To Melas then, thus aware that a powerful French Army was moving on Ivrea and Chivasso, the following considerations should have presented themselves:—First. If Napoleon was aiming to advance on Turin, Melas could assemble his army from the Var from Genoa, and from the valley of the Po at Asti or Alessandria, so that the opposing armies, supported each on its proper base, might put the fate of Piedmont to the issue of a battle, where the Austrians, resting on their fortresses, ought, with their concentrated position, their very superior cavalry, and their veteran troops, to prevail. Secondly.—If Napoleon's aim proved to be Milan, Melas, with his army united as before, might act by the Tesino upon Napoleon's communications; when the French, if defeated, would have no retreat except by the St. Gothard pass, in which they must abandon their artillery. Lastly.—If Napoleon should decide to operate by the right

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bank of the Po, in Melas's rear, the Austrian general had every facility to operate by the Tesino and Adda, and thus re-open the communications of the army, by abandoning Piedmont for the moment.

But in all these suppositions the first condition of success was the prompt retreat of Elsnitz from the Var on Coni, or the Col di Tenda, or even on Fossano, in order to effect his junction with Melas whenever it might be desirable, else he would be cut off. But Melas could not yet prevail on himself to withdraw the troops from the Var, thus uncovering the siege of Genoa, which must in that case also be abandoned. He persuaded himself that Napoleon's aim was to unite with Thurreau upon Turin; and that, by standing fast around that city, he might give Ott time to take Genoa. When that should be effected, there would be nothing to prevent him from recalling all his troops from the country south of the Apennines, and uniting them to his main army.

In this view, up to the 28th May, his instructions to his generals were to fortify Moncaglieri, Carignano, and Casal, points on the Po above and below Turin; and he ordered Wukassowitch, who commanded the forces (10,000 in number) in the valleys of the Sesia and Tesino, to defend the Tesino as long as possible (for Melas did not yet know of Moncey's march to turn the line of that river), and, when obliged to give way, to fall back to Pavia and pass the Po there.

By that time, however, Wukassowitch was in no condition to obey his orders. His detachments were posted in the Tesino valley watching the St. Gothard, at Domo d'Ossola opposite the Simplon, and in the valley of the Sesia. The latter force was now effecting its retreat before the French columns that threatened to envelope it. The detachment at Domo d'Ossola, attacked in front by the force from the Simplon, while the Italian brigade from Grassoney menaced its rear, hastily retired across the Lago Maggiore; and while his troops were thus dispersed the advanced guard of the French crossed the Tesino at the moment when Moncey's vanguard engaged his right at Bellinzona.

To keep Melas in the delusion that Turin was the object, and to mask the advance on Milan, Bonaparte ordered Lannes on the 28th to attack Haddick on the Orco. He also extended a "curtain of observation" in the shape of a line of detachments along the Po, through which he could observe the enemy, unseen himself. Its front thus covered, the army defiled from Ivrea, on the Milan road. Murat's rearguard now became the advanced guard and moved on the Tesino, near which it formed on the 30th May, followed by the divisions of Loison and Victor. It was in anticipation of such a movement that Melas had ordered Wukassowitch to defend the Tesino; and it was in reliance on his lieutenant's ability to check the enemy there, that he still remained with so large a force about Turin. But all the troops available for the defence of the river were some cavalry, the detachments being scattered, as already related, by the French advance; the nearest troops were those from Domo d'Ossola, which were marching down the bank. The Tesino is wide, deep, and rapid; and, though a canal from Oleggio conveys great part of its waters to Milan, it continues to form a formidable obstacle to an army. The canal runs parallel, or nearly so, to the river for some distance, and the Austrian cavalry commander, fearing to engage his men in that narrow

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space, placed only some picquets there. Murat, having pushed his cavalry parties far up the stream to divide the enemy's attention, directed, on the 31st May, one division on Turbigo and another on Buffalora. With the aid of some small boats the adjutant-general, Girard, transferred himself and a few men to the left bank; he was supported, little by little, by a regiment, and by the fire of batteries from the other side, and the cavalry fell back before him, crossing the canal. The Austrian detachment from Domo d'Ossola, hearing the firing, hastened its march, and reached Turbigo in time to drive Girard's men from the village; but he defended the canal bridge till the whole division crossed to his assistance, and finally repulsed the Austrians, who retired on the Adda through Milan, throwing a garrison into the citadel as they passed. Wukassowitch sent orders to the detachment pressed by Moncey at Bellinzona to retire by Varese and Monza on Cassano. On the 2d June Napoleon entered Milan.

Pursuant to his orders, Lannes, on the 28th, attacked Haddick vigorously on the Orco, and at the close of the action he seemed resolute to resume the attack next day. But, immediately after its close, he drew his division together, and followed the direction of the rest of the French army marching from Chivasso, by the road that borders the Po, on Pavia, at which place he seized considerable stores, 8,000 muskets and 200 guns, forty of which were field-pieces.

The Army of Reserve, with the exception of Thurreau's force, which was still at Susa, and Chabran's conscripts which after the fall of Bard were ordered to Ivrea to cover the communication with the St. Bernard, was now assembled in the space between the Tesino, the Adda, and the Po. The retreat of Wukassowitch left the road on Milan clear for Moncey; nevertheless, he came but slowly. While awaiting him Napoleon made the following dispositions.

Duhesme and Loison pushed Wukassowitch back on the Mincio, and drew up before Pizzighitone, Cremona, and the tête-de-pont of Piacenza, all occupied by Austrian detachments. Napoleon organised a civil government at Milan, took measures to counteract the designs of the enemies of France there, and made arrangements for the supply of his troops. These matters occupied six days. On the 6th and 7th of June he reviewed Moncey's troops, as they came in by regiments; and he issued an order, of which the following is a part:—

"Soldiers!

"One of our departments was in the power of the enemy; consternation reigned over the whole of the South of France.

"The greater part of the territory of the Ligurians, the most faithful friends of the Republic, was invaded.

"The Cisalpine Republic, annihilated by the last campaign, was become the sport of a ridiculous feudal domination.

"Soldiers! you march—and the French territory is already free! Consternation and dread are succeeded by joy and hope in our country.

"You will restore liberty and independence to the people of Genoa, who will be for ever delivered from their inveterate foes.

"The enemy, panic-struck, hope only to regain their frontiers. You have taken from them their stores, their magazines, and their reserves of artillery.

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"The first act of the campaign is ended.

"But shall the violation of the French soil pass unpunished? Will you suffer those soldiers who have carried terror into your families to return to their firesides? Well, then! march to meet them—oppose their retreat."

This bulletin, bombastic, as usual, in tone, sums up, not unfairly, the results of his operations thus far. Three weeks before, these kingdoms were passive under the domination of a hundred thousand Austrians, who, confident of their hold on Italy, aimed at invading France. The mere *direction* of Napoleon's line of march, had, without any general collision with, or even sight of, the main body of the enemy, relieved France, and forced Austria to abandon all her acquisitions. Such are the results of the principles of strategy applied by a master of the science. Had he now been content simply to wait at Milan, he would have seen the Austrians descend the right bank of the Po to rest on Mantua and the Mincio, when, joined by Suchet and the garrison of Genoa, he, with his back towards France, would have faced them with 80,000 men ready to dispute *all* attempts to recover their conquests. To most generals such a result would have seemed too glorious to be risked for the chance of still further triumphs. But the conclusion of his address showed that nothing but the destruction of the Austrian army would satisfy him, and to that end he now prepared to cross the Po.

The country north of the Po, through which he had been operating, was a great plain watered by the streams of the Alps, which flow parallel to each other, like ribs, to fall into the great central stream. Flat, and abundantly watered, the country here was marshy, intersected everywhere with dykes, dams, and ditches, and the great roads were on causeways. The cultivated portions were vineyards and mulberry gardens, rendering still more difficult the advance of troops. Such a country is evidently ill adapted for the operations of cavalry, in which the Austrians were very superior. South of the Po, the Apennines, pushed inwards by the Gulf of Genoa, gradually approach the river, till, from Stradella to Piacenza, they form with it a narrow pass. In this pass lay the high road, the Austrian line of retreat from Turin and also from Genoa, for the more direct route from the latter place to Piacenza by the valley of the Bobbio was difficult for the march of any troops except infantry. So long as the Austrians held the places on the left bank, especially the Bridge of Piacenza, they could safely retire on Mantua even in the presence of Napoleon on the other side; but, if he held the bridges and posted himself on the right bank, they must break through him or surrender. Before Moncey's arrival he dared not throw a considerable force across the river, because, had he done so, and the Austrians crossing at Casale and Valenza had marched on the Tesino, he could not recall the force from the right bank in time to oppose them, and they would have broken through his feeble cordon, crushing him, perhaps, in detail as they passed. But, as soon as Moncey joined, he commenced the decisive operation.

The corps of Victor, Lannes, and Murat, 28,000 in all, were thrown at three different points across the Po. But the troops remaining on the left bank, viz. Thurreau's and Chabran's detachments, the force lining the Tesino, the garrisons of Crema and Brescia, and the detachments before Cremona, Pizzighitone, and Arona, numbered 29,000. Thus only

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half the Army of Reserve was directed on what was almost certain to be the point of collision. On such a point all the force available should be brought to bear. "No detachments," says Napoleon himself, "on the day of battle." Yet he was now seeking battle and detaching half his army. Thurreau's absence could not be helped, because there was no way from Susa to Milan except by passing the Austrians at Turin: Chabran's force was necessary to cover the line of communication. It was also necessary to blockade the garrison in the castle of Milan, who, if free to issue forth, might have done mischief. Making these deductions then, with some posts to watch the Po between the Sesia and Tesino, there would be a necessary diminution of 11,000. Adding 3,000 more posted at Lodi to check the garrison of Pizzighitone and the attempts of Wukassowitch, there would be 14,000 instead of 29,000 on the left bank; thus 15,000 additional men would have been available for the operation on the right bank, and to move them thither would have been to avoid a great error, for Napoleon ran the risk of losing, in the defeat which his inferiority rendered imminent, all the advantage he had won. This he afterwards acknowledged, but accounted for the false step by saying that he was intoxicated with success, and was determined to gain all or nothing.

His idea in thus dividing his army was to guard against the escape of Melas by the left bank. Should the enemy cross the Po at Casal or Valenza, Napoleon trusted that Moncey, with the 10,000 men immediately available, would defend the line of the Tesino till he could recross with the remainder to his aid. But 50,000 Austrians could certainly in three marches have forced their way by Pavia to Piacenza, and by destroying or guarding the bridges would have prevented him from re-crossing at all. There was, moreover, this circumstance to simplify the operations of the Austrians, that, having already lost their communications with their proper rear, they were not hampered as armies ordinarily are by considerations for preserving them, and had only to break through a line which, from Pavia to Arona, extended about fifty miles, and which thrice ten thousand men would have been wholly inadequate to guard.

Before describing the operations on the left bank, it will be necessary, in order to follow them, to return to Melas.

On the 28th May he burnt the bridge of the Orco, to prevent Lannes from pursuing Haddick. On the 29th he looked for the resumption of operations in that direction, expecting to find the whole French army directed on Turin, when, to his astonishment, he heard that Lannes was moving on Chivasso and the army on Milan. He could still have anticipated them at Placentia or Cremona, and consequently at Mantua. But he was still unwilling to relinquish his chance of taking Genoa, or of passing the Var, which he must do at once if he decided to retreat; besides, that would be to abandon without a blow all his conquests in Italy. Hoping that Wukassowitch would, according to orders, defend the line of the Tesino, he resolved himself to attack the French line of retreat by Vercelli, thus cutting off Lannes from the main body, while Wukassowitch checked Napoleon in front. This movement was actually begun on the 31st, when, for the first time, he heard of Moncey's advance, and the hasty retreat of Wukassowitch behind the Adda.

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Awake at last to the perils that enveloped him, he suspended the advance on Vercelli, because, to make an important movement while the enemy threatened his rear, he must first concentrate his forces, or the distant corps might be separated from him and lost. Lannes was thus extricated from what would have been a difficult or ruinous position, and allowed to pursue peaceably his march on Pavia. The orders for assemblement were explicit. Elsnitz was to leave the Var and move by Tenda, Coni, and Asti, on Alessandria. From Nice to Asti is eighty miles—four marches; he might therefore have been on the Bormida on the 5th or 6th of June. The corps about Turin was also, as soon as Elsnitz should be abreast of that place, to move on Asti, leaving a garrison in the citadel to defend it against an enemy from Susa or Chivasso. Ott was to raise the siege of Genoa in the night following the reception of the order, and, leaving a rear-guard to defend the Bochetta pass, was to march by Bobbio on Piacenza. The distance was about fifty miles—and he might, therefore, supposing him to receive the order on the 2nd, have been at Piacenza on the 5th of June. Had he obeyed his orders the Austrian army would have been saved, for, Piacenza being suitably occupied, Napoleon could not cross the Po. But a momentary success prevented the march of Ott—a bait offered by the evil destiny of Austria.

Hitherto the opposing forces on the Var and at Genoa might be left out of the immediate problem of the campaign, because they neutralised each other. But now events at both those points began to complicate the situation. On the 28th of May, while Napoleon was moving towards Milan, Suchet, after repulsing an attack, assumed the offensive. Elsnitz had been originally ordered, in case he should be obliged to fall back, to cover Genoa by taking post behind the Roya. The subsequent orders of the 31st to retire by Tenda had not reached him, and, while he was attempting to carry out his original instructions, Suchet turned his right. The courier coming with the orders by Tenda was therefore obliged to turn about and make a long detour by Ormea, and Elsnitz continued to fall back towards the Ormea pass. Retiring too precipitately, two of his divisions were cut off in the mountains by the French advance, and on the 7th of June he reached Ceva, having lost in that terrible retreat more than half of his eighteen thousand.

Suchet now moved on Genoa, knowing his path was clear. But he received news which stopped him.

Massena, as has been said, had tried to notify Napoleon that he could not hold out beyond the 24th of May. There was already some talk of capitulation on the 26th, when Colonel Franceschi arrived off Genoa with the news that he had seen the French army descend from the St. Bernard. Pursued by an English cruiser, he jumped overboard and swam ashore. The intelligence he brought induced Massena to hold out yet ten days. On the 31st May some overtures were made and received, and on the 2nd June the famine among the troops and inhabitants, who had suffered also two days' bombardment from Keith's fleet, was so dreadful that he promised to treat with Ott if not succoured in 24 hours. Accordingly next day, the 3rd, he sent his Adjutant-general to Ott. The latter had in the meantime received from Melas the news of Napoleon's move-

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ment on Milan, and the order to raise the siege; he had also heard, indirectly, of the disaster of Elsnitz. No doubt he felt the urgent necessity of moving at once; and yet to abandon the siege which had cost him so much when the enemy was on the point of surrender seemed too great a sacrifice. He persuaded himself that if Melas had known the enemy's condition the order would not have been given. Massena would have decided the question for him had the news of Napoleon's presence in Italy reached Genoa, but he was ignorant of it, though his envoy it is said actually met the officer who brought the intelligence in Ott's ante-room. A conference was therefore held on the 4th, in which it was agreed that the French should evacuate the place with arms and baggage, 8500 by land, 1500 with Massena by sea to Antibes. Ott placed 10,000 men in Genoa. The French who marched out joined Suchet on the 6th June between Savona and Finale, and that general then pushed his advanced posts to Montenotte.

On the 5th June Gottesheim's division from Ott's force quitted Genoa by Bobbio for Piacenza; on the same day Vogelsang's division marched for Tortona, and on the 6th Ott himself followed with Schellenberg's division. The cavalry of Gottesheim's division march by Tortona.

Although on first hearing of Moncey's march Melas had ordered Kaim and Haddick to unite at Alessandria, yet, as Elsnitz was now coming from Ceva with greatly diminished forces, it was considered indispensable to cover the Alba road, which might else be open to Thurreau's attacks from Susa. Kaim and Haddick were therefore ordered to remain in the camp at Turin till the 8th or 9th.

But on receiving the news of blow after blow—the hasty retreat of Wukassowitch on Mantua and Cremona—the junction of Bonaparte and Moncey—the shattered condition of Elsnitz's corps when it arrived at Ceva—and, finally, the junction of the French troops from Genoa with Suchet, Melas saw how urgent it was to guard against these new dangers by measures of the utmost promptitude. Prince Hohenzollern, the commandant of Genoa, was ordered at once to expel the 1500 French who were still awaiting embarkation, and who refused except by sea to quit the place, where their presence obliged the Austrians to keep a larger garrison than they could spare. The defence was to be intrusted to 3000 Austrians whom Massena had captured, and who were unfitted by the privations of the blockade for service in the field. The rest of the garrison was to march on Piacenza, and Keith was requested to replace it by an English garrison from Minorca. Troops from the line of the Po were to move instantly on Piacenza. Ott's divisions were to be directed by forced marches on that place, and Hohenzollern was to follow three or four days behind. They were to defend the bridge of Piacenza to the last extremity. The rest of the troops, except those in garrison, were to move on Alessandria, where they were expected to unite before the 12th. Some of these orders were probably despatched on the 8th, but on that day Napoleon was across the Po.

On the 6th, Lannes, from Pavia, collecting all the boats he could, was passing the river opposite Belgiojoso. Some Austrian troops marching from about Casal arrived there at the time and attacked the battalions that crossed first, but these held their ground till others crossed to their

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support, when the Austrians were driven back, and Lannes' division formed on the 7th with its back to the river, overlooking the Stradella road.

On the 6th, Murat, with the cavalry and one division from Lodi, attacked the *tête-de-pont*, or fortification covering the bridge at Piacenza. This work, which the Austrians had rather neglected because it did not appear of importance in the plan of campaign, had been repaired between the 3rd and 5th, but only 200 men defended it, and the nearest re-inforcement was engaged with Lannes at Stradella. Therefore, hopeless of aid, they abandoned the *tête-de-pont* in the night after repulsing Murat's attack, and crossed the river to Piacenza, destroying the bridge. Thereupon Murat, out of the materials of the broken bridge, made a new one at Nocetto, below Piacenza, and crossed. Duhesme also carried Cremona, and crossed there after Murat.

It was now that scattered parties of the Austrians, making for Piacenza in all haste, began to arrive, but only to find themselves anticipated at the decisive point. First the Austrian general, Oreilly, marching at full speed by the Turin road with some squadrons of cavalry, came up. Besides the unexpected presence of the French, he was further embarrassed by a large park of artillery which followed him, being the reserves of Melas despatched from Alessandria towards Mantua for safety. Oreilly threw two companies of infantry into the castle of Piacenza—probably the former garrison of the *tête-de-pont*—and with his cavalry attacked the French who had crossed at Nocetto. At the same time also, but without concert, the regiment which formed the advanced guard of Gottesheim's division, coming by Bobbio, entered Piacenza. They were driven out by the French, and what remained of them rejoined the division, which wandered about without orders for several days. Oreilly retreated on the road he came by, breaking through the advanced posts of Lannes, and the artillery park was saved for the present, as the conflict in the town gave it time to retrace its steps, and shelter itself in Tortona. Lastly, a regiment of Austrians, coming from Tuscany by Parma, also encountered Murat's division, and was driven back to Firenzuola.

Ott's two remaining divisions were re-united at Novi on the 7th, and continued their movement on Piacenza. He would not believe that the mass of the French army was crossing the Po; he believed it to be moving on Mantua. Why he should suppose that an army, which already held a point on its adversary's communications, should march fifty miles further, when at only one march from that point which it was most important to maintain—viz. the defile of the Po and Apennines from Stradella to Piacenza—does not appear. However, with the idea that he would find before him only a fraction of the French, he crossed the Scrivia on the 8th, camped at Voghera, and pushed his advanced guard to Casteggio, where Oreilly rallied upon it.

Hohenzollern, who was to have joined Ott, remained with his division in Genoa. He refused to leave the place without a second order, because Admiral Keith declared himself unable to bring troops from Minorca without the sanction of their general, Abercrombie, who was on his way from England.

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Napoleon was unable to leave Milan till the 8th, though he foresaw an immediate action. He ordered the divisions that had already crossed to concentrate at Stradella, telling them that they would probably be attacked by a force from Genoa, on the 8th or 9th. Lannes was in position before Stradella with 8000 men when Ott advanced; but, instead of being at the mouth of the defile, as Napoleon intended, he was beyond it; his left on the spurs of the Apennines, his centre on the high road towards the village of Casteggio, his right on the flat bank of the Po. On the 9th the Austrians brought on an action, and Lannes, after a stout fight, was giving way, when a division from the rear came up to his support, and the battle, which was most hotly contested about Casteggio, was renewed till the Austrians were broken and retreated to Montebello, losing from 4,000 to 5,000 in this severe action, from which Lannes derived his title of Duke of Montebello. Just at its close Napoleon appeared on the field.

Ott fought at Montebello to drive back the French on the right bank, and recover Piacenza. Lannes fought, though inferior in numbers, because he knew that all the French that had crossed were coming up in his rear; he knew too that, with the river behind him, a retrogade movement might be most disastrous. Ott had about 18,000 men; he saw before him only an inferior force; he was ignorant of the movements in support of Lannes, and his orders to move on Piacenza were positive. Had he known the true state of affairs, his policy of course would have been to join Melas for the final attempt to break through.

Collecting his divisions, and falling back to the mouth of the Stradella pass, Napoleon spent the 10th and 11th in strengthening that position, and increasing his communications across the Po. On the 11th he was joined by Desaix, the most gifted, next to Napoleon, of all the generals ripened by the Revolution. He had lately won a great name in Egypt, and had now come to serve in one last battle under the great soldier whom he reverenced. Napoleon placed him in command of the divisions of Monnier and Boudet.

The position of Stradella, supported on the flanks, strengthened in front, and unsuitable to cavalry, in which the Austrians were greatly superior, was rendered further favourable to Napoleon by numerous farm-houses and villas, which, so strongly built as to be cannon-proof, would diminish the effect of the numerous Austrian artillery. Genoa having fallen (as he had learnt about the 8th), there was now nothing to press his further movements, and his true policy was to await events at Stradella. His part was a defensive one—because the active measures to recover their supplies lay with the Austrians, who, if they remained inactive, would thereby suffer the worst consequences of defeat; viz., utter and hopeless disorganisation. Since they were thus compelled to seek him, he should have taken care that they should find him in a position which assured him of all the chances of victory. But his genius was always active and impatient. He began to doubt whether the Austrians were not escaping by the left bank and the Tesino—he feared, too, that, leaving a force in Alessandria to mask their movements, they might, with greatly superior forces, march to overwhelm Suchet. These considerations, constantly recurring, urged him, on the afternoon of the 12th, to quit Stradella, and to quiet his anxieties by coming face to face with his enemies. They were,

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or ought to have been, greatly superior to him in all arms—but his confidence and hardihood led him to believe that their only thought was how to escape him. On the 13th he crossed the Scrivia, below Tortona. An attempt made by Victor to occupy the town under the fire of the citadel failed, and the place was masked by a battalion.

Melas, marching from Turin on the 8th with the divisions of Kaim and Haddick, reached Alessandria on the 10th.

He had three plans to consider: to recover his communications by the left bank of the Po—to force his way by the right bank through the French—to retire on Genoa.

The left bank, as has been said, offers ground far less favourable for cavalry than the right, which may have induced him to set aside that consideration.

The retreat on Genoa offered many advantages. He could hold his ground there against any French force that would be likely to come against him. Keith's squadron would easily provision his army—and in the last resort he could embark, and transport it to Tuscany. But to effect this he must march at once, or Suchet would block the passes of the Apennines.

But to abandon all this conquered territory without a battle seemed too pusillanimous. The French signally defeated might be driven back over the Alps, and all disasters remedied. He resolved therefore to put his fate to the issue of a battle.

Having once resolved on this, his first measure should have been to call in all available detachments. To what purpose should he continue to guard his present flanks and rear, when the best thing that could happen to him would be to find the French behind or on one side of him, instead of across his present front? He had in Alessandria 30,000 troops, of whom 8,000 were cavalry, with 200 guns. At Turin and Coni he had 8000 men; at Casal, Feliciano, and Alessandria, 6600. It was necessary to leave a force in Turin, to prevent Thurreau from coming on his rear—and 2000 would have sufficed for Coni. By drawing the others to him he could have assembled 10,000 more than he had on the day of battle.

Napoleon committed what had nearly been a ruinous fault when he debouched with his inferior cavalry and fewer guns into the great plain of Marengo. To add to the risk, he detached one division of Dessaix's corps towards Rivalta, to guard against Hohenzollern, whom, from false intelligence, he believed to be advancing with the garrison of Genoa by the Novi road. He left Monnier's division of Dessaix's corps at Ponte Carone, and 1600 cavalry at Castel Novo, to maintain the communication with Pavia—and then advanced across the plain of Marengo with the troops that remained, 15,000 infantry, 2000 cavalry, and 40 guns. One reason which caused this imprudence probably was, that the road by which Melas must march to Genoa crossed the plain of Marengo. If then he could throw himself across this road, Melas would be restricted to two of the three alternatives already enumerated.

Having reached San Giuliano without hearing anything of the enemy, he caused the plain to be scoured for news, but none was obtained. But Victor, marching in advance, came at last on the remains of Oreilly's defeated troops in the village of Marengo, attacked and drove them out of

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the village back on the Bormida, and even attempted to seize the bridge, but the fire of the batteries of the camp, and the guns of the *tête-de-pont*, caused him to retire towards Marengo.

Judging from the ease with which the Austrians were forced from the village, Napoleon concluded that the main body could not be in Alessandria, or it would have supported so important an outpost. Urged by his doubts, he returned to the Scrivia, on his way to get intelligence from the Po and Tesino; but the river suddenly overflowing prevented him from crossing, and he remained for the night on the bank, at the tower of Garofolo.

That day Melas had held a council of war at Alessandria, the opinion of which was unanimously for attack; and, accordingly, next morning the Austrians filed in three columns over the bridges of the Bormida.

Two roads cross the plain towards Alessandria; one by Tortona and St. Giuliano, by which the French had marched; the other nearer the Po, by Salé, across the Scrivia, to Pavia. On this latter road is a village called Castel Ceriolo, where the French right rested; abreast of it in the plain between the two roads is Marengo, and a muddy rivulet—the Fontanone—runs along the front of the villages, making a loop on the left of Marengo towards the Tanaro. The French line was from Castel Ceriolo on the right, through Marengo, to the Fontanone on the left. The line was held at first by Victor's corps alone, that of Lannes being behind him on the plain; Dessaix was still towards Rivalta, Monnier behind the Scrivia, but both were moving in haste to the field at the urgent summons of Napoleon.

Melas's plan was to direct one column against the French centre at Marengo, another smaller one against their left, while Ott, with 8000 men, turned Castel Ceriolo on their right. He made several mistakes in his arrangements. First, though he had two bridges to file over, he had only one issue from the *tête-de-pont* which covered them; for which reason only one column could pass at a time, and Ott's, which had furthest to march, was the last to issue forth; consequently he was not in position to engage till long after the others. Secondly, as if to compensate for Napoleon's fault of detaching Dessaix, Melas, hearing that Suchet was approaching Acqui, and not considering that, even if it were true, that circumstance could not influence a battle which must be decided in a few hours, detached more than 2000 horse on the Acqui road. Thirdly, it was a grand error under the circumstances to attack the village of Marengo at all. Under ordinary circumstances it could not be neglected—but these were no ordinary circumstances. Melas had no communications to guard; when he issued from Alessandria, it should have been in the firm determination not to retreat upon it—his sole thought should have been how to enter the plain with all his forces, and form front to the enemy in any direction except his present one. His attack on Marengo should have been a feint, and his whole force after making that feint should have followed Ott under cover of his superior artillery upon the Salé road. They would thus have been on the plain, on the flank of the French, and able either to fight or move towards the Po.

However, instead of this, the Austrians engaged in an obstinate and bloody fight along the Fontanone, which, as well as Marengo, proved a

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most formidable obstacle. Still, as soon as Ott came up on the French right, they pressed back Victor and Lannes by weight of numbers. Napoleon, at this juncture, appeared with Monnier's division, and for a time restored the battle, but the French were again overmatched, and driven in scattered order across the plain, till their left rested on San Giuliano. Had Melas now possessed his 2000 cavalry in reserve, the French retreat would have become a rout, and Marengo would have been an Austrian triumph. As it was, affairs looked so well for the Austrians, that Melas, worn with fatigue, left the field to despatch intelligence of his victory to Genoa, Turin, and the Aulic Council. The Austrians, committed to Zach, the chief of the staff, were formed in long columns previous to following up their success by a march.

At this moment Dessaix with his fresh troops appeared on the field. It is said that Napoleon thought at first of employing these to cover his retreat; but he presently resolved to use them in a last effort for victory. Supported by the only French guns now serviceable, and by Kellermann's horse, Dessaix formed line in front of San Giuliano; the head of the advancing Austrian column was surprised, enveloped, charged in flank by Kellermann, and finally dispersed. The other columns in rear made valiant attempts to stem the torrent and to deploy on the plain, but the head of every formation was enveloped and destroyed, and at nightfall the whole army lately victorious was flying across the Bormida back to Alessandria.

Melas had been puzzled by the near and nearer approach of the cannonade towards Alessandria; but his doubts were soon removed by the fugitives who poured in. The night was spent in trying to restore some order, and in distributing supplies. "Day," as an Austrian journal expressed it, "came to show the sad wreck of a battle won." Melas was still considering how to retrieve the stroke when he learned that his redoubtable adversary had summoned the *tête-de-pont*, and had formed his columns of attack. Under these circumstances, and seeing that his position was further complicated by the advance of Suchet towards Acqui, he made overtures for a convention.

Napoleon on his part was willing to treat. His losses in the battle had been considerable; the Austrians were still formidable and might renew the action; they might escape by the Tesino; they might turn and overwhelm Suchet, and shelter themselves in Genoa; therefore he received the envoy of Melas with consideration, and the convention of Alessandria was concluded.

By it the Austrian army was permitted to pass to the Mincio; 60,000 soldiers were thus saved to the empire. In return Melas surrendered all the fortresses and citadels in front of the Mincio up to the frontier and the sea.

The great soldier's dreams of the reconquest of Italy were thus realised in less than four weeks by the unfailing execution of a nearly perfect plan; and the campaign of Marengo remains one of the most wonderful examples of that system of a war of marches, which, originating in the necessities of the French republic, was so constantly and gloriously illustrated by Napoleon.

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Friday, March 16th, 1860.

The Right Honourable The EARL of ELLENBOROUGH, G.C.B., in the Chair.

ON THE NECESSITY, DESCRIPTION, ORGANISATION, AND COST OF NATIONAL DEFENSIVE MEASURES.

By Lt.-Col. JOHN PITT KENNEDY, formerly an Officer of the R.E., Military Secretary to the late General Sir C. Napier when Commander-in-Chief in India, &c.

1. THE Defence of the Empire embraces the protection—

First. Of Great Britain and Ireland;
Second. Of British Colonies throughout the world;
Third. Of British and Colonial Commerce on the High Seas.

2. These important interests must be protected not only against the possible aggression of the most powerful states single-handed, but likewise against the combinations of such states taken collectively.

3. We may fairly reason on what may be attempted in future from what has actually been done in times past.

England was conquered by the landing of foreign forces on her shores.

In later times the military resources of the first Napoleon enabled him to provoke, and, with 180,000 men, for years to maintain, a conflict against England, Spain, and Portugal, and simultaneously to launch a million of men against the Russian Empire, whilst, having beaten Austria into temporary servility, he kept Prussia in a state of perpetual castigation; and although from his having undertaken too much at a time, from England's preponderating naval force in those days, from the tenacious resistance of British sailors and soldiers in every conflict, finally, from the combination of the very elements against him in Russia, his ruin was effected, it is not difficult to imagine how different might have been the results had he conciliated Russia, until, by concentrating and personally directing his vast resources against the Peninsula, he had settled the Spanish question, and had he above all succeeded in making his Navy equal to that of England, which latter appears to be a cherished policy of the reigning Emperor.

4. Neither is it difficult in the present day to conceive a French and Russian alliance for aggressive objects against England, thus opposing to her two absolute monarchs sustained by nearly a million and a half of first-rate soldiers, with large and increasing navies, and having the entire resources of their respective empires at their individual control.

5. Against these and all other combinations defensive measures must be effectually calculated. When the interruption of peace and industry depends upon the will of individual men representing half a million or a

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million of well-trained warriors, their neighbours are bound to adopt the requisite precautions in due time.

6. The passage of the Pruth is but five years past. It was the headstrong act of one man. It lighted the torch of war, and extinguished a large amount of the commercial and industrial energy of the world, and particularly of England, from that day to the present time.

7. The still more recent passage of the Ticino was likewise the act of another individual leader of armies.

Fortunately both those aggressors were defeated in the conflicts they provoked, but no such penalties could atone for the wide-spread evils which their acts entailed. The precautions and attitude of peace-loving nations should be such *as to control the occurrence of war*, not merely to secure victory when attacked.

8. Up to the passage of the Pruth forty years of tranquillity had led England to imagine that improved political axioms had extinguished for ever her European wars, and, notwithstanding the recent proofs to the contrary, there are still those who venture to assert that the necessity for defensive measures is but a nightmare of weak minds.

As long as absolute rulers find themselves at the head of vast armed masses effectual preventatives must be established on a commensurate scale by their neighbours, and those nations that neglect the required precautions will sooner or later pay the forfeit of their improvidence.

9. The Duke of Wellington, scanning the effects of steam years ago, urged the necessity of national defensive measures. His was not the vision of a disordered or timid brain, but the calculation of the most capable mind that England has ever produced to deal with such a subject, on data derived from the most extensive practical experience. His admonition was neglected on the falsest principles of both policy and finance, and, whatever may have been the amount *of absolute aggressive peril which the country has since gone through with impunity*, there can be no doubt that the industrial and commercial injuries sustained by the neglect of his advice, *in the periodical commercial panics* which that neglect has produced, would have paid manifold the cost of any rational defensive system that could have been adopted.

What reasonable sacrifice in the way of national defence could be compared to the withholding of British capitalists' investments for the employment of the people and the development of home and colonial wealth and industry?

10. It may then be assumed that the power of both internal and external defence must be effectually established, cost what it may, and that the only question is, Upon what principle can it be most effectually and safely established?

11. This question involves the consideration of both our land and sea forces, their respective amounts compared with those of other countries, and the due application of each to its peculiar duties.

12. It is clear that British commerce on the high seas, which is the very breath of our nostrils, as it sustains the existence and progress of 206 millions of British subjects, can only be protected by the Navy.

That in like manner the British colonies spread over the globe must be mainly protected by the same force, and that the magnitude of these two

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interests compared with those of any other nation, or of all other European nations put together, gives not only the right but the obligation to maintain a British naval force, which, whatever its strength, can excite no rational jealousy or suspicion on the part of other countries. The only limit to that force must be the prudential one, affecting ourselves alone, of what it may cost.

13. Great Britain, however, has a just right to look with distrust on, and narrowly to scan the motives of, any large naval increase in other states beyond what their own national requirements demand. This is the true scale by which the amount both of land and sea force in every state ought to be calculated, throwing out altogether the element which confers the power of foreign aggression.

14. Land and sea forces on a legitimate system should come down to the simple scale of a military police. They can only be forced beyond this, in states pacifically disposed, by the existence, as in Europe, of the aggressive scale adopted by some arbitrary neighbouring states; and where that scale exists, even in an individual case, other states, however pacifically disposed, must necessarily raise their own armaments to this standard, or place themselves in extreme peril.

15. To the European standard then by some means England must come, if she is to enjoy security, peace, and *free industrial action*.

It has been shown that under the present state of things British colonies, amounting to 2½ times the area of Europe, with nearly as large a population, and British commerce, must be mainly protected by the Navy.

The first line of defence for the home empire must likewise be the British Navy; and yet it would appear that, after two unexampled years of activity in strengthening our fleet, it is still far below its proper comparative amount.

16. The relative scales of population and commercial activity existing under the protection of the respective flags would justify a British naval force more than fivefold that of France and threefold that of Russia, or twice their aggregate amount, and these considerations not only justify but demand that England should maintain, if not double the amount, at least a large preponderating naval force beyond the combined fleets of those two nations.

17. The administrative duties of the British Government to its widely-spread population justify a land force equal to twice the aggregate force of France and Russia; yet the actual amount of British troops of the Line is under one-fifth of the united forces of those two states, or one-tenth of what the comparison with them would justify! And it must not be forgotten that the 53 nations existing under the protection of the Sovereign of England are scattered through every part of the world, requiring that the British forces should be broken into a corresponding number of detachments, thus justifying a much larger comparative aggregate of force than where the subjects to be protected are concentrated, as they are in other states. Where, then, is the motive to be found for these disproportionate armaments of our neighbours, at least as regards their navies? This is a question which every statesman, nay, every English man, is bound to solve.

18. The Emperor of the French, with all his sagacity, would never

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embarrass his finances to create an enormous navy merely as a yacht fleet.

That fleet is unquestionably composed of ships of war, built for some purpose of war, and the world cannot present him with any other antagonist than England against whom such a fleet as he has built could be required to act.

It is clear, then, upon every ground, that the naval preponderance of England must be restored, cost what it may.

19. The shortest and best mode by which this international adjustment of naval forces could be restored, would be by the French Emperor voluntarily handing over such a portion of his fleet, *at cost price*, as would effect the result. It would, in fact, be the soundest financial and political act of his reign, practically confirming his declaration "L' Empire c'est la paix." Nor would it in any way affect the ultimate relative proportions of the respective navies, as otherwise England must accomplish the required result by building and expenditure. It is entirely a financial question, involving equally the interests of both nations.

20. A strong Home Fleet must undoubtedly be the first line of defence for the British Islands.

But to make the Navy the only defence, or even the principal defence, as regards England, would cripple the Government in the employment of its naval forces, and would either leave the distant possessions of the empire unprotected, or would require so preposterous an expenditure as must revolt the mind of any reflecting man, and still leave us insecure.

England, the focus of the Empire—the source from which investments extend to the vast British Colonies, and the consequent mainspring of their development; the cradle and asylum of civil and religious liberty throughout the globe; the most detested object of arbitrary power; the chief emporium of the world's wealth; the most tempting military booty—hence, the most inviting point of attack, but the most worthy and most easy of defence! What, then, is to be the principal permanent defence of England?

21. The estimates of the Army and Navy for the current year 1860-61 must be considered in reference to this question:—

Army	£14,842,275
Navy	12,802,200
Total Army and Navy .	£27,644,475

Of this very much increased amount as compared with former years, a considerable portion is to supply some of those lamentable deficiencies which had been permitted through views of mistaken economy to reach a point perilous to the security of the nation, and which are now being gradually remedied. Here, then, we have—

One year's estimate of military establishments .	£27,644,475
Added to an annual charge for former wars of about	28,000,000
Making a total of	£55,644,475

or about five-sixths of the entire state revenue, applied to the payment for past and present military establishments.

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This includes, it is true, the charge for those 20,000,000*l.* which were expended to erase the stain of slavery from the flag of England.

Such an amount of military expenditure is no doubt most lamentable, though far preferable to the alternative of becoming a province of the French empire! This must be our consolation for past incumbrances, as well as the stimulus for future defensive preparations.

22. The Navy Estimates provide a force of 54,000 men of all ranks for the fleet, in addition to the Coast Guard and the crews of training, surveying, troop, and store ships. The average cost per man of all ranks appears to be about 60*l.* per annum. The estimates likewise provide a force of 18,000 marines of all ranks, at an average cost of 49*l.* each per annum. But the most important feature of these estimates is the determination evinced—

1st. To strengthen our naval position by the *required* numerical increase of steam ships of war.

2nd. To establish a certain rapid means of manning the fleets of England.

23. All honour to the existing Government for their efforts to restore to its right relative standard the true characteristic force of the British Empire. Honour, too, to their immediate predecessors, who effected so much in the same direction, and in so short a time. How earnestly must that course still be pursued, when we find that the French steam navy is far beyond its proper relative strength, and is daily adding to that strength; that the Russian navy is making a similar progress; that the French and Russian navies can with safety be dismantled, because their shores are amply protected without them, and they can be re-commissioned with *facility*, certainty, and rapidity, whilst, if the British fleets be reduced, they can only be manned with difficulty, uncertainty, and delay; finally, that the French and Russians are still rapidly building new ships of war!

24. How is this destructive competition to end, and what is its object?

If continued, the result must be financial ruin to the weakest treasury, and great injury to all.

Its sole and unmistakeable object is hostility to the naval position of England, a position which England cannot compromise or risk whilst she has a man or a shilling left for its reinforcement and security. The destruction of the British fleet would be but the first step to the dismemberment of the British empire.

The Admiralty are frequently catechised as to where their ship-building is to have a limit. This question can only be answered by the Emperors of France and Russia.

25. The cessation of our naval competition rests entirely with Russia and France. Even were they to cease building, England must continue until she has her proper relative amount of ships; and, though France and Russia may dismantle their fleets, England must keep hers in commission, until she has actually established as certain and rapid a mode of re-manning those ships as that adopted by either France or Russia; when so situated, and not sooner, England can venture to reduce her fleet if others will do the same.

26. Hence, the effectual mode of securing moderate Navy Estimates,

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together with national safety, in future years, must rest upon the measure intended to provide a copious reserve force of seamen; until that great fact is fully achieved, he will be a hazardous statesman who shall venture to reduce the fleet of England below a full war establishment, equal to cope with all that may be arrayed against it.

The start of a few months in completing 30 sail-of-the-line, or other preponderating force, for sea, after a mutual disarmament, would give to the first out an incalculable power of conquest and destruction.

27. The French are stated to have a reserve force of seamen amounting to 90,000 men. This would appear to be an incredibly large number—be that as it may, England should have a certain reserve force *equal to the difference between her lowest peace establishment and the complement required to man every effective ship in the navy.*

28. We may assume, for the sake of illustration, that this reserve complement would reach to 60,000 men, costing annually a retaining payment of 6*l.*, 7*l.*, 8*l.*, or even 10*l.* each as compared with the same number afloat, costing 60*l.* each per annum.

60,000 reserves	at 6*l.*	would amount	to per annum	360,000*l.*
„	at 7*l.*	„	„	420,000*l.*
„	at 8*l.*	„	„	480,000*l.*
„	at 10*l.*	„	„	600,000*l.*

60,000 afloat at 60*l.* each, would amount to 3,600,000*l.* per annum. Thus the saving that would attend a reserve establishment receiving the high retaining salary of 10*l.* would on this comparison be 3,000,000*l.* annually.

In fact the establishment of a certain sufficient reserve force of seamen is the only principle which can justify any safe reduction of importance in the fleet during even the most profound peace as compared with a full war establishment.

29. Those who look back with confidence to British naval triumphs in former wars, as the index of what may still be achieved, must recollect that the transition from sailing-vessels to steamers destroyed the numerical superiority of our ships, which an improvident administration of affairs delayed to restore, and that the suppression of the arbitrary press-gang system, which formerly manned our ships with rapidity, was not followed by any certain mode of supply. The reserve principle recently suggested has not yet proved successful: *additional inducements*, however, must make it so.

30. The objects of a general defensive system for England must be—

1st. To be able to man as large a fleet with as much rapidity as any combination of hostile states can bring against us.

2nd. To leave the great mass of the navy disposable, if required, for the protection of commerce and the colonies, reserving only a strong channel fleet as a first line of defence for Great Britain and Ireland.

3rd. To establish so overwhelming an internal organisation of land forces as shall render the home empire perfectly secure against external aggression, *even in the absence of the channel fleet.*

4th. To accomplish these results effectually at the smallest possible cost.

31. The army estimates provide a line force of 148,362 men of all

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ranks, with 14,632 horses charged to the British revenue, and 92,490 men with 9,710 horses charged to the Indian revenue.

Thus the effective British troops of the line amount to 235,852 men of all ranks, including artillery, engineers, cavalry and infantry, of whom 92,490 are for service in India, nearly 50,000 are detached to other colonies, and over 90,000 remain in Great Britain and Ireland. The average annual cost of British troops of the line of all arms and ranks appears to be about 63*l.* per man, exclusive of non-effective charges.

32. The presence of 90,000 troops of the line within the home empire is a consideration well calculated to remove alarm; rarely have the numbers of any British force, opposed to their foes in fight, approached one-third of that amount, and the marvellous power of conveying troops in Great Britain could effect the concentration of these 90,000 men upon any given point inviting an attack, within a few hours. Then why misgivings? The simple answer is, that the regular troops in England are but the fluctuating balance of the colonial garrisons, liable at an hour's notice to be called, as lately they were, to the most distant regions of the earth. In this extended empire, the possibility of such contingencies must ever be kept in view, and provided against.

33. Those whose fiat turns peace into war do not measure our troops by their prowess, but by their limited numbers as compared with their own vast masses; they do not look back to the unequal conflicts through which British troops have carried their country in triumph; and there is no question that the steady industrial progress of the people of England can only be secured by making it quite palpable that not only in quality, but in numbers, are their defenders most formidable. If those numbers can be arrayed without any considerable cost, and without diverting any class from the productive pursuits of industry, this difficult problem will have been solved.

34. A large increase of the regular army would not meet these conditions; neither would the militia principle, nor any other which involves payment for the service given.

35. The principle which does appear applicable, is a well-organised volunteer force, meaning an association of loyal men, so strongly attached to the institutions of the country as gratuitously to form themselves into a well-organised military force for internal defence, and to effect this with such hearty good will and perseverance as shall enable them to prefer the regular indispensable training which it will entail *to the usual recreations that fill up the leisure hours of industrious men.* Such is the high characteristic of the movement which is now exhibiting itself throughout Great Britain.

36. The difference between the militia principle and that of the volunteer is remarkable in several respects. The militia soldier must be paid by the State whilst embodied for training, because during that time he must neglect his ordinary means of livelihood, risking his power of resuming it when the training ceases, and, when disembodied, he neglects his practice as a soldier until he is again called out.

The volunteer costs, comparatively, nothing as a soldier, because his productive time for earning a livelihood is not interfered with, neither is his training or practice as a soldier interrupted, for he devotes to it

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daily and weekly only his spare time, instead of following some other recreation. His military pastime injures neither his employer nor himself. The militia soldier ceases during his training to invest his industry in producing wealth; the volunteer continues as usual his productive industry.

37. On the other hand, unless the volunteer force be thoroughly organised, sufficiently numerous, and rightly distributed, its effect must be rather inimical than advantageous; it would lull the nation into imaginary security, whilst neighbouring rulers would be perfectly cognisant of its shortcomings.

A limited number of skirmishers would be a mere delusion; volunteers, to be effectual as a reinforcement to our regular troops, must be organised in battalions and brigades. They must be able to act in solid bodies, and to meet in line the best foreign troops.

38. The total male population capable of bearing arms in Great Britain may be estimated at about 5,000,000, of whom one-tenth would more than supply the demand for the navy, coast guard, marines, troops of the line, and militia, and one-tenth more would give an effective volunteer force of 500,000 men. The latter would not in any way be withdrawn from the productive industry of the country.

39. The most important element in a general volunteer organisation for Great Britain must be a proper selection of territorial districts and sub-districts, that shall be suited to the assembling for exercise of the different sized squads or bodies of men which constitute an organised force: viz.

One section of 25 men.
One subdivision of two sections, or 50 men.
One company of four sections, or 100 men.
One battalion of 10 companies, or 1,000 men.
One brigade of several battalions.
One division of several brigades.
One corps d'armée of several divisions.

40. The census registration districts offer the best existing arrangement in this respect, giving, as they do, the details both as to area and population of great divisions, counties, districts, and sub-districts, thoroughly ascertained, and classified on a principle quite analogous to what would be requisite for a methodised volunteer organisation for objects of national defence.

41. At the same time, the density of population in reference to area is so very variable in different localities as to require much forethought in adapting the proper details to the circumstances of every case.

The average population of town districts in Great Britain per square mile is . .	3,337
That of country districts	120

Thus, on the assumption that 1 in 40 of the population, or 1 in 10 of adult males, would give a sufficient effective force of volunteers (say 500,000 men), one average mile of town district would produce 83 volunteers, whilst a like extent of average country district would produce but three.

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42. Averages, however, give but vague, and often misleading, notions. Of 624 census districts of the third class, comprised in England and Wales, and containing an average area of about 90 square miles each, with an average population of about 28,730 souls, the most dense town district (No. 17, East London) contains a population of 185,751 to the square mile, whilst the least dense country district (No. 557, Bellingham, in Northumberland) contains but 18 souls to the square mile ; and there is every intermediate variety of density per square mile between these two wide extremes.

43. In the district of maximum density, a single square mile would produce on the scale here proposed 4,643 volunteers, or a formidable brigade, whilst, in the district of minimum density, above 200 square miles, or a space 14 miles long by 14 miles wide, would be required to produce a single company of 100 men. In the former case of a dense town district, the volunteers forming a battalion of 1,000 men would be as convenient to a well-selected centre for training drill as a regiment of the line when in barracks.

In the latter case of a thinly, but uniformly, peopled country district, the drill centre for a single company of only 100 men would give a mean distance of nearly five miles for the volunteers to arrive at their assembling point, and the same distance to return after a drill of (say) two hours. This would be an impracticable task to impose for a continuance upon men in the evening, after an ordinary day's work, which would be their only available time for training.

44. In purely country districts, therefore, the drill squad would probably be one section of 25 men, or one-fourth of a company, which, assuming the full proportion of the volunteers, would rarely require more than one mile for any one to reach his drill centre.

45. Of the population of Great Britain, about one-half resides in town districts offering every facility for their assembling in considerable masses, say regiments of 1,000 men, for drill; one-half resides in country districts, where, for the reasons assigned, the drill squad must necessarily be small, as sections of 25 men, sub-divisons of 50 men, and, probably, companies of 100 men each, in the densest localities.

46. The Table No. 1 gives the principal census organisation of England and Wales in 11 grand divisions, subordinate to which there is the requisite classification of five progressive degrees of sub-districts.

47. The map shows how completely this arrangement can be made subservient to a military defence of the country by volunteer corps in support of the regular troops.

48. The proportional force of each grand division, referring to a total force of 500,000, would naturally be enrolled with reference to the strategical importance of each locality. In some districts one-twentieth of the adult males would be a sufficient force, whilst in others four times that ratio might be desirable.

49. In the First great military Division, London, comprising the town portions of Middlesex, Surrey, and Kent, an enrolment of one-fifth of the adult males would furnish a force of 118,000 men.

50. The Second, or South-Eastern, Division is equally important, and should have the same proportion, one-fifth; it would comprise the rural

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portions of Surrey and Kent, with the counties of Sussex, Hants, and Berks, and would give a force of over 81,000 men. Head-quarters, Portsmouth.

51. The Third, or South Midland, Division would comprise the country portions of Middlesex, with Hertfordshire, Berks, Oxfordshire, Northamptonshire, Huntingdonshire, Bedfordshire, and Cambridgeshire, and, assuming an enrolment of three-twentieths of adult males, would furnish a force of 46,000 men. Head-quarters, Bedford.

52. The Fourth, or Eastern, Division would contain Essex, Suffolk, and Norfolk, and, giving three-twentieths of adult males, would furnish a force of 41,000 men. Head-quarters, Bury St. Edmund's.

53. The aggregate of the forces of these first four divisions would produce 286,000 men, available against any enemy attempting to reach the metropolis. It would include the defence of the arsenal and various dockyards on the Thames, and the approach to London by that river, the dockyard of Portsmouth, &c.

54. The Fifth great Division, or South-Western, would comprise Wiltshire, Dorsetshire, Devonshire, Cornwall, and Somersetshire. It embraces a considerable portion of the south coast, and should be estimated at the highest rate of enrolment, or one-fifth, which would furnish 90,000 men. Head-quarters, Plymouth.

55. Viewing the paramount importance of the foregoing five divisions, we have estimated as above the aggregate number of 376,000 men for their local defence. They comprehend, in fact, the most important portion of the empire, and that at once most inviting and most open to attack, which, if well secured, will go far towards protecting the whole.

It must be kept in mind, too, that a volunteer system of defence should be based upon the employment of the forces as near as possible to their own localities.

Thus the districts calculated to provoke or invite attack should have within themselves a much larger proportion of volunteers than the others; a proportion of one-twentieth of their adult males might probably suffice for nearly all the remaining divisions of Great Britain.

56. The Sixth Division would be the West Midland, containing Gloucestershire, Herefordshire, Shropshire, Staffordshire, Worcestershire, and Warwickshire, which, taking one-twentieth of the adult males, would muster 26,000 men as a central reserve, ready to support any point attacked. Head-quarters, Birmingham,

57. The Seventh, or North Midland, Division, comprising Leicestershire, Rutlandshire, Lincolnshire, Nottinghamshire, and Derbyshire, on the same scale of one-twentieth, would give 15,000—Head-quarters, Grantham—and would likewise be a disposable reserve.

58. The Eighth, or North-Western, Division would be Cheshire and Lancashire, which, enrolling one-twentieth, would muster 31,000 men. Head-quarters, Manchester.

59. The Ninth, or York, Division. The three ridings of Yorkshire, at one-twentieth, would furnish 22,000. Head-quarters, York.

60. The Tenth, or Northern, Division: Durham, Northumberland, Cumberland, and Westmoreland, at one-twentieth, would give 12,000 men. Head-quarters, Carlisle.

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61. The Eleventh, or Welsh, Division: Monmouthshire, with North and South Wales, at one-twentieth, would give 15,000 men.

62. The Twelfth, and last, Division would comprise the northern and southern counties of Scotland, mustering, at one-twentieth, 36,000 men, with head-quarters at Stirling.

63. The result of thus regulating the enrolment of volunteers would be to give a total volunteer force of about 535,000 men in Great Britain, of whom about 376,000, or over two-thirds of the entire, would be concentrated within those districts most exposed, and most inviting to any hostile attack. It will be a somewhat difficult, and a very important, matter, thus to regulate the formation of corps by stimulating their enrolment only in the ratio of the relative importance of their presence in the respective districts.

64. There is now a distinct course of action to be selected out of several that suggest themselves—

1st. Matters may go on as formerly, without any preparation whatever, accompanied from time to time, as hitherto, by discreditable acknowledgments of weakness, and followed by wasteful commercial panics, until the irremediable disaster which such a course invites and merits shall occur; or,

2nd. The regular line forces may be increased, and costly fortresses may be erected, until our means of resistance shall have become superior to any possible aggressive combination against us; but the consequence of such a course must be financial ruin, with other serious objections; or,

3rd. The present high national feeling may be fostered and wisely directed, until the volunteer force reaches those dimensions, and that efficiency in the precise districts calling for it, which, at small cost, shall reinforce the regular troops, and render the home empire perfectly secure, both from real danger and commercial panics.

65. Thus far the 12 principal divisions of Great Britain have been dealt with, as suited to an army organisation, in reference to the requirements of command, and the power of local inspection.

66. It is desirable to offer some more intelligible estimate as to how this territorial arrangement would tend to promote enrolment and practical organisation by the adoption of such small districts as would come within the personal knowledge and influence for good of every man in Great Britain.

This will be found in the 12 Tables of subordinate districts, which form sub-multiples not only of the great military divisions already referred to, but likewise of the counties composing those great divisions; thus retaining the indispensable co-operation of the existing county authorities under the respective lords lieutenant.

From these 12 Tables, which exhibit England and Wales in 624 districts, and Scotland in 72 districts, every man can find the locality with which he is intimately acquainted, and wherein, knowing what is expected of it, he would naturally promote by his labour and influence the great public object in which his personal interests are so deeply involved.

67. The Tables will show the number of males capable of bearing arms in each district; the average number of effective volunteers which the population would produce on the scale of one in 20, one in 10, or one in 5,

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of males capable of bearing arms; they likewise contain a column to show the proper establishment of volunteers that should be enrolled in reference to the strategic importance of each division with a view to its efficient defence.

68. Assuming that the enrolment of effective volunteers may reach the estimate suggested for Great Britain, or about 500,000 men, the proportions of cavalry and field artillery suitable may be taken at two squadrons of 100 men each, and a field battery of six guns, to every brigade of three battalions of infantry, 500,000 volunteers would thus produce of

Infantry, 450 battalions of 1,000 men each;
Cavalry, 300 squadrons of 100 sabres each;
Artillery, 150 field batteries of six guns.

There can be no more difficulty or cost for those who already keep horses for objects of enjoyment, or even industry, to enrol themselves for the artillery or cavalry, than for those who do not keep horses to enrol themselves for the infantry.

69. Of the hundreds of English pastime clubs, from the horse-race to the cricket, the yacht down to the skittle, there is none that can give more excitement and amusement than the meets for training and practice of artillery, cavalry, and infantry corps.

70. It will be indispensable to the success of an efficient artillery, that the Government should be prepared to furnish the best description of guns and carriages for field batteries, where volunteers are found to provide the horses, gunners, and drivers.

71. The present volunteer movement is indeed a grand exhibition of wisdom, energy, and patriotism; and so long as such a national spirit exists, and is wisely directed, England can have nothing to apprehend. But, to produce its effect, it must be wisely directed. Like all first efforts, it must have its incidental errors.

72. One of the most general rules for enrolment is, that each volunteer should pay an entrance fee and an annual subscription, besides giving his time and exertions gratuitously, and meeting the expenses of his uniform.

The result of this rule in my own district is, that, whereas our proportion of an aggregate force of 500,000 men should be over 1,300, we have as yet enrolled less than one-tenth of that number.

The subscription principle would, in fact, exclude the working classes, and thus render the whole undertaking a failure. It is therefore essential that this rule should be erased, and that every good man who has the spirit to join for the common defence shall be received without either entrance fee or annual subscription, otherwise the required numerical force cannot be obtained.

73. In opening the volunteer corps to every class in Great Britain, it would be very wrong to overlook the qualification of unblemished character. This point should be especially secured, because the maintenance of discipline and good conduct cannot be so strictly enforced by "Articles of War" as in a regular army.

74. Whilst the most general rule now is to charge entrance fees and annual subscriptions, aid is in some districts given towards the supply of

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uniforms. This would appear to be an error in the opposite direction. The uniform ought to be an inexpensive and neatly cut dress, such as would not exceed the cost of a mechanic's holiday suit. It might, therefore, be furnished by himself. The money subscription, as a rule, he cannot and will not pay.

If one-tenth of the ablebodied men devote their *spare* time and trouble gratuitously to the service of the State, it is not too much to expect that the remaining nine-tenths should furnish the small amount of money required for the general objects of organisation, if the Government itself should hesitate to do so.

75. An economical administration would probably keep the annual expenditure of a general character within 2*l.* per man enrolled, making, at the largest rate, the cost for 500,000 men 1,000,000*l.* per annum; and 2*l.* per man who serves, levied upon those who do not serve, would be but a nominal rating. In practice, the rich classes in this country would probably, as is usual, take such a contribution voluntarily upon themselves. Better still would be the principle of rendering it *quite certain*, by making it a public charge. Its effect would probably be to reduce, by many times its own amount, what must otherwise be the future taxation of the country.

It would be, in fact, the best and most provident national insurance ever effected against disaster and risk, and it would produce its annual bonus in the shape of reduced taxation.

76. The organisation being in battalions, and the drill centres regulated by the density of the population, either for an entire battalion, a wing, a company, a subdivision, or a section, in order to facilitate the regular attendance of the volunteers, by securing that the drill centres shall be as close as possible to their respective homes, the lieutenant-colonel of each battalion should have an adjutant and sergeant-major, both thoroughly trained soldiers. He should, with their assistance, train his officers. After the first week of such training, the officers would be sufficiently advanced to meet their respective companies in the evening, and communicate the first lessons they themselves had acquired to the men, and so go on progressively, until all were perfect. Where the battalion could assemble at one point there would be every facility for perfect training. Where the companies have separate drill grounds the adjutant should have training charge of the companies of one wing, the sergeant-major those of the other wing; each attending alternately the companies under his instruction at their evening drills to assist the company officers.

77. There has been much cost and inconvenience incurred, in consequence of the enrolment and drill having commenced at the wrong season, winter; rooms have been hired at heavy rents, and drill-sergeants paid to instruct only a few men. In the spring and summer all those inconveniences will vanish. The long evenings and fine weather will admit of drill parades in the open air, after the usual working hours of artizans, &c. The Saturday half-holiday, now so general, will facilitate much the training. It will enable the battalions to unite their companies, and turn out for a field-day once a week; and, in dense districts, to meet for brigade drill once a month, three or more battalions together.

78. The enrolment of volunteers demanded as a preliminary the appoint-

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ment of a responsible officer, charged with the organisation and inspection of the entire force.

That appointment has just been conferred upon an officer admirably suited, by his past experience, for the task confided to him.

His military rank, however, should be increased, to give his opinions and advice due weight.

The counsel of a general officer would be received with respect, when his inferior in rank might be little heeded.

79. The tendency to introduce varieties, by way of "improvements," in different corps, will be strong in proportion to the inexperience of the parties seeking to make such innovations; and these can only be counteracted by judicious and patient perseverance on the part of the responsible inspecting general, who will necessarily require a local deputy inspector of sound discretion and military experience in charge of each of the 12 great military divisions.

This principle of inspection, sustained by the presence of an adjutant and sergeant-major on permanent duty with each battalion of infantry, each regiment of cavalry, and each field-battery of artillery, will produce a well-organised and efficient force. But without at least this proportion of officers, bound to devote their entire time to produce unity of action, and the observance of certain fixed military principles, it would be idle to expect any result of a permanent or useful character, notwithstanding the high motives and vigorous spirit by which this great national effort has been thus far so universally distinguished.

80. The power of concentrating troops upon any point is probably more perfect in Great Britain than in any other country in the world.

Taking London as the principal base of operations and the principal point of defence, our communications cannot be cut off. The worst that can happen is, that we should be attacked at some outpost, which at the shortest possible notice can be fully reinforced by any desired proportion of our entire forces.

Assume that six trains can convey a brigade of 3,000 men on a well-graded line furnished with perfect machinery;

That trains can follow each other, as they frequently do, at intervals of a quarter of an hour;

This will enable 3,000 men to be started along each railway going towards any given point every hour and a half, or in 12 hours 36,000 men, and in 24 hours 72,000 men by only one line of railway; and if there be two lines of railway converging to the point of concentration these numbers would be doubled, if three they would be trebled, &c.

As there are ten lines converging at London which ramify a little way from London into about twice the number, these could pour in their reinforcements at the rate of 20,000 men an hour.

Several points on the South Coast have two, some three, converging lines, and nearly every point is approached to within five miles by at least one line of railway. Thus the minimum power of concentration upon any point of that important district would be about 48,000 men in 24 hours, and the power to approach some of the most interesting points, as Portsmouth for example, would be thrice that ratio.

The power of concentration is perfect, and the whole question of defence

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is confined to that of whether the troops themselves shall exist in sufficient numbers within the limits of the home empire.

81. Startling projects are whispered of costly fortresses, involving an expenditure of 10,000,000*l.* or 20,000,000*l.* England is precisely the country where fortresses would be least applicable. They would lock up our valuable but too scanty troops, who would be required to operate actively in the field against their foe, wherever he may present himself; and lamentable indeed will be our case if we ever give an enemy time to sit down before a British fortress.

82. The only fortresses we require are floating fortresses, and of those we cannot have too many. The cost of one fortress on shore, which would do more harm than good, would provide several additional ships of war, capable of adding their ubiquitous protection to the flag of England wherever it is hoisted, from our Sovereign's palace to the uttermost ends of the earth. We may indeed require on shore a few very powerful batteries, closed at the gorge, to defend certain approaches to harbours, &c. but this should be the extent of our preparation of that class. Then, with our preponderating ships of war, and a well-equipped field force, sufficiently numerous, well organised, and well commanded, to fulfil its important charge, we shall have nothing to apprehend.

83. Where is the commander to be found who would hazard to attack a better fleet than his own, for the purpose of landing an army on a shore protected by a nation of well-organised, well-commanded, and stout-hearted soldiers, more brave, better equipped, and far out-numbering the invaders? *These are the elements to be established for England's defence*, and not fortresses, which would keep no invader off if our fleets are inferior to his, and our troops less numerous and less efficient; the ships and the troops will do the work without the fortresses, but the fortresses will be of no avail without the same preponderance of ships and a larger amount of troops. It is to be hoped, then, that no financial effort to provide fortresses, which are not essential, may be permitted to cripple the establishment of the fleet, and the troops, which are essential not only to the military defence and security of England, but likewise to the *uninterrupted* progress of every class of her inhabitants engaged in or affected by the pursuits of trade, commerce, and industry, in their infinite and complicated ramifications.

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TABLE No. 1.—SUMMARY of TWELVE MILITARY DIVISIONS proposed for GREAT BRITAIN in reference to ORGANISATION of VOLUNTEER FORCES, showing the relative force of VOLUNTEERS that each DIVISION can furnish on different scales in proportion to their TOTAL NUMBER of MALES capable of bearing ARMS, and the best proportion suited to the required FORCE for each DIVISION.

DIVISION.	Area in Square Miles.	Estimated Effective Volunteers.				
		1-20th of Adult Males.	1-10th of Adult Males.	1-5th of Adult Males.	Best suited for Requirements of the Different Divisions.	
					Proportion of Adult Males.	Number.
1. London Division	122	29,511	59,042	118,099	4-20ths	118,099
2. South-Eastern Division	6,352	20,560	40,764	81,600	,,	81,600
3. South Midland Division	5,002	15,265	30,832	61,689	3-20ths	45,795
4. Eastern Division	5,022	13,899	27,823	55,672	,,	41,697
5. South-Western Division	7,804	22,505	45,047	90,135	4-20ths	90,135
6. West Midland Division	6,013	26,624	53,286	106,614	1-20th	26,624
7. North Midland Division	5,527	15,161	30,344	60,707	,,	15,161
8. North-Western Division	3,144	31,252	62,504	125,008	,,	31,252
9. York Division	5,710	22,337	44,704	89,433	,,	22,337
10. Northern Division	5,457	12,100	24,211	48,438	,,	12,100
11. Welsh Division	8,167	14,842	29,700	59,418	,,	14,842
12. Scotch Division	31,324	36,108	72,218	144,436	,,	36,108
Total of Great Britain	89,644	260,164	520,475	1,041,249	..	535,750

TABLE No. 2.—SUMMARY of DIVISIONS, showing the COUNTIES included in each, and the relative force of VOLUNTEERS that can be furnished by each DIVISION and COUNTY, on different scales, in proportion to their TOTAL NUMBER of MALES capable of bearing ARMS; also the most suitable proportion for the required FORCE of each DIVISION and COUNTY.

DIVISION AND COUNTY.	Area in Square Miles.	Estimated Effective Volunteers.				
		1-20th of Adult Males.	1-10th of Adult Males.	1-5th of Adult Males.	Best suited for Requirements of the Different Divisions.	
					Proportion of Adult Males.	Number.
1. LONDON—						
Middlesex (part of)	51	21,808	43,630	87,271	4-20ths	87,271
Surrey (part of)	36	6,026	12,058	24,119	,,	24,119
Kent (part of)	35	1,677	3,354	6,709	,,	6,709
	122	29,511	59,042	118,099	,,	118,099
2. SOUTH-EASTERN—						
1. Surrey	744	2,525	5,057	10,122	4-20ths	10,122
2. Kent	1,584	6,050	12,113	24,261	,,	24,261
3. Sussex	1,484	4,286	8,580	17,171	,,	17,171
4. Hampshire	1,658	5,014	10,039	20,090	,,	20,090
5. Berkshire	882	2,685	4,975	9,956	,,	9,956
	6,352	20,560	40,764	81,600	,,	81,600
3. SOUTH MIDLAND—						
6. Middlesex (part of)	276	1,879	3,762	7,528	3-20ths	5,637
7. Hertfordshire	669	2,172	4,346	8,695	,,	6,516
8. Buckinghamshire	629	1,792	3,588	7,179	,,	5,376
9. Oxfordshire	749	2,124	4,253	8,507	,,	6,372
10. Northamptonshire	988	2,628	5,241	10,686	,,	7,884
11. Huntingdonshire	321	753	1,506	3,013	,,	2,259
12. Bedfordshire	477	1,619	3,242	6,488	,,	4,857
13. Cambridgeshire	893	2,298	4,794	9,593	,,	6,894
	5,002	15,265	30,832	61,689	,,	45,795

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Table No. 2.—Summary of Divisions—*continued.*

DIVISION AND COUNTY.	Area in Square Miles.	Estimated Effective Volunteers.				
		1-20th of Adult Males.	1-10th of Adult Males.	1-5th of Adult Males.	Best suited for Requirements of the Different Divisions.	
					Proportion of Adult Males.	Number.
4. EASTERN—						
14. Essex	1,536	4,293	8,594	17,197	3-20th	12,879
15. Suffolk	1,454	4,194	8,395	16,799	,,	12,582
16. Norfolk	2,032	5,412	10,834	21,676	,,	16,236
	5,022	13,899	27,823	55,672	,,	41,697
5. SOUTH-WESTERN—						
17. Wiltshire	1,216	3,005	6,016	12,042	4-20th	12,042
18. Dorsetshire	962	2,208	4,422	8,850	,,	8,850
19. Devonshire	2,671	7,146	14,301	28,611	,,	28,611
20. Cornwall	1,377	4,451	8,909	17,826	,,	17,826
21. Somersetshire	1,578	5,695	11,399	22,806	,,	22,806
	7,804	22,505	45,047	90,135	,,	90,135
6. WEST MIDLAND—						
22. Gloucestershire	1,119	5,237	10,481	20,968	1-20th	5,237
23. Herefordshire	665	1,236	2,474	4,953	,,	1,236
24. Shropshire	1,413	3,055	6,117	12,240	,,	3,055
25. Staffordshire	1,179	7,873	15,756	31,521	,,	7,873
26. Worcestershire	678	3,227	6,461	12,931	,,	3,227
27. Warwickshire.	959	5,996	11,997	24,001	,,	5,996
	6,013	26,624	53,286	106,614	,,	26,624
7. NORTH MIDLAND—						
28. Leicestershire	831	2,932	5,869	11,743	1-20th	2,932
29. Rutlandshire	168	303	606	1,213	,,	303
30. Lincolnshire	2,718	4,995	10,000	20,005	,,	4,995
31. Nottinghamshire	937	3,676	7,355	14,715	,,	3,676
32. Derbyshire	873	3,255	6,514	13,031	,,	3,255
	5,527	15,161	30,344	60,707	,,	15,161
8. NORTH-WESTERN—						
33. Cheshire	1,083	5,416	10,832	21,664	1-20th	5,416
34. Lancashire	2,061	25,836	51,672	103,344	,,	25,836
	3,144	31,252	62,504	125,008	,,	31,252
9. YORK—						
35. West Riding	2,637	16,737	33,489	66,992	1-20th	16,737
36. East Riding and York	1,142	3,174	6,355	12,715	,,	3,174
37. North Riding	1,931	2,426	4,860	9,726	,,	2,426
	5,710	22,337	44,704	89,433	,,	22,337
10. NORTHERN—						
38. Durham	1,178	5,142	10,287	20,578	1-20th	5,142
39. Northumberland	1,952	3,790	7,583	15,172	,,	3,790
40. Cumberland	1,565	2,440	4,883	9,770	,,	2,440
41. Westmoreland	762	728	1,458	2,918	,,	728
	5,457	12,100	24,211	48,438	,,	12,100
11. WELSH—						
42. Monmouthshire	676	2,213	4,425	8,853	1-20th	2,213
43. South Wales	4,401	7,583	15,175	30,360	,,	7,583
44. North Wales	3,090	5,046	10,100	20,205	,,	5,046
	8,167	14,842	29,700	59,418	,,	14,842
12. SCOTCH—						
45. Southern Counties	9,000	22,669	45,339	90,678	1-20th	22,669
46. Northern Counties	22,324	13,439	26,879	53,758	,,	13,439
	31,324	36,108	72,218	144,436	,,	36,108
	89,644	260,164	520,475	1,041,249	,,	536,750

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No. I. DIVISION.—LONDON.

Volunteer Force should be 4-20ths of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
MIDDLESEX.		
West Districts.		
1 Kensington	30,000	6,000
2 Chelsea	14,184	2,836
3 St. George's, Hanover Square	18,807	3,661
4 Westminster	16,402	3,280
5 St. Martin-in-the-Fields	6,160	1,232
6 St. James, Westminster	9,101	1,820
	94,105	18,819
North Districts.		
7 Marylebone	39,424	7,884
8 Hampstead	2,996	599
9 Pancras	41,739	8,347
10 Islington	23,832	4,766
11 Hackney	14,607	2,921
	122,598	24,517
Central Districts.		
12 St. Giles	13,553	2,710
13 Strand	11,115	2,223
14 Holborn	11,655	2,331
15 Clerkenwell	16,194	3,238
16 St. Luke	13,514	2,702
17 East London	11,101	2,220
18 West London	7,197	1,439
19 London City	13,983	2,796
	98,312	19,661
East Districts.		
20 Shoreditch	27,314	5,463
21 Bethnal Green	22,548	4,509
22 Whitechapel	19,940	3,988
23 St. George-in-the-East	12,094	2,418
24 Stepney	27,594	5,518
25 Poplar	11,790	2,356
	121,280	24,274
SURREY.		
South Districts.		
26 St. Saviour, Southwark	8,933	1,786
27 St. Olave, Southwark	4,844	968
28 Bermondsey	12,032	2,406
29 St. George, Southwark	12,956	2,591
30 Newington	16,204	3,240
31 Lambeth	34,831	6,966
32 Wandsworth	12,691	2,538
33 Camberwell	13,667	2,733
34 Rotherhithe	4,451	891
	120,609	24,119
KENT.		
35 Greenwich	24,841	4,968
36 Lewisham	8,709	1,741
	33,550	6,709
Total of No. I. Division	590,564	118,099

No. II. DIVISION.—SOUTH EASTERN.

Volunteer Force should be 4-20ths of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
1. SURREY—exclusive of London Districts.		
37 Epsom	4,760	952
38 Chertsey	4,037	807
39 Guildford	6,288	1,258
40 Farnham	2,936	587
41 Farnborough	1,960	392
42 Hambledon	3,388	677
43 Dorking	2,838	567
44 Reigate	3,582	716
45 Godstone	2,217	443
46 Croydon	7,972	1,594
47 Kingston	6,696	1,339
48 Richmond	3,976	795
	50,630	10,122
2. KENT—exclusive of London Districts.		
49 Bromley	4,409	881
50 Dartford	6,832	1,366
51 Gravesend	4,156	831
52 North Aylesford	4,142	828
53 Hoo	711	142
54 Medway	10,699	2,139
55 Malling	4,895	979
56 Sevenoaks	5,524	1,104
57 Tunbridge	7,136	1,427
58 Maidstone	9,024	1,804
59 Hollingbourn	3,438	687
60 Cranbrook	3,367	553
61 Tenterden	2,920	584
62 West Ashford	3,328	665

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No. II. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
Kent—*continued.*		
63 East Ashford	2,990	596
64 Bridge	2,791	558
65 Canterbury	3,525	705
66 Blean	3,665	733
67 Faversham	4,171	834
68 Milton	3,006	601
69 Sheppey	3,346	669
70 Thanet	7,949	1,589
71 Eastry	6,290	1,258
72 Dover	7,081	1,416
73 Elham	4,695	939
74 Romney Marsh	1,359	271
	121,351	24,261
3. SUSSEX.		
75 Rye	3,087	616
76 Hastings	5,304	1,061
77 Battle	3,558	711
78 Eastbourne	2,087	417
79 Hailsham	3,322	664
80 Ticehurst	3,877	775
81 Uckfield	4,406	881
82 East Grinstead	3,304	660
83 Cuckfield	3,902	780
84 Lewes	6,430	1,286
85 Brighton	16,392	3,278
86 Steyning	4,217	843
87 Horsham	3,504	700
88 Petworth	2,407	481
89 Thakeham	1,858	571
90 Worthing	4,686	937
91 Westhampnett	3,662	732
92 Chichester	3,759	751
93 Midhurst	3,400	680
94 Westbourne	1,736	347
	84,900	17,171
4. HAMPSHIRE.		
95 Havant	1,803	360
96 Portsea Island	18,081	3,616
97 Alverstoke	4,227	845
Hampshire—*continued.*		
98 Fareham	3,481	696
99 Isle of Wight	12,581	2,516
100 Lymington	3,036	607
101 Christchurch	2,120	424
102 Ringwood	1,419	283
103 Fordingbridge	1,708	341
104 New Forest	3,385	677
105 Southampton	8,524	1,704
106 South Stoneham	3,993	798
107 Romsey	2,702	540
108 Stockbridge	1,870	374
109 Winchester	6,415	1,283
110 Droxford	2,674	534
111 Catherington	623	124
112 Petersfield	1,953	390
113 Alresford	1,854	370
114 Alton	2,977	595
115 Hartley Wintney	2,806	561
116 Basingstoke	4,386	873
117 Whitchurch	1,405	281
118 Andover	4,216	843
119 Kingsclere	2,227	445
	100,498	20,090
5. BERKSHIRE.		
120 Newbury	5,204	1,040
121 Hungerford	5,101	1,020
122 Faringdon	3,968	786
123 Abingdon	5,236	1,047
124 Wantage	4,356	871
125 Wallingford	3,541	708
126 Bradfield	4,095	819
127 Reading	5,544	1,108
128 Wokingham	3,417	683
129 Cookham	2,942	588
130 Easthampstead	1,588	317
131 Windsor	4,847	969
	49,806	9,956
Total of No. II. Division	407,085	81,600

No. III. DIVISION.—SOUTH MIDLAND.

Volunteer Force should be 3-20ths of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
6. MIDDLESEX—exclusive of the London Districts.		
132 Staines	3,493	522
133 Uxbridge	4,869	729
134 Brentford	10,331	1,548
135 Hendon	3,979	594
136 Barnet	3,655	546
137 Edmonton	11,324	1,698
	37,651	5,637
7. HERTFORDSHIRE.		
138 Ware	4,120	618
139 Bishop Stortford	5,089	762
140 Royston	6,589	987
141 Hitchin	6,182	927
142 Hertford	3,772	564
143 Hatfield	2,125	318
144 St. Albans	4,501	675
145 Watford	4,700	705
146 Hemel Hempstead	3,280	492
147 Berkhamstead	3,132	468
	43,490	6,516

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No. III. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
8. BUCKINGHAM-SHIRE.		
148 Amersham	4,659	696
149 Eton	5,372	804
150 Wycombe	8,390	1,257
151 Aylesbury	5,768	864
152 Winslow	2,344	351
153 Newport Pagnell	5,777	864
154 Buckingham	3,602	540
	35,912	5,376
9. OXFORDSHIRE.		
155 Henley	4,474	669
156 Thame	3,910	585
157 Headington	3,943	591
158 Oxford	5,043	756
159 Bicester	3,890	582
160 Woodstock	3,613	540
161 Witney	5,889	882
162 Chipping Norton	4,357	651
163 Banbury	7,442	1,116
	42,561	6,372
10. NORTHAMPTON-SHIRE.		
164 Brackley	3,437	513
165 Towcester	3,201	360
166 Potterspury	2,666	399
167 Hardingstone	2,289	342
168 Northampton	8,464	1,269
169 Daventry	5,481	822
170 Brixworth	3,693	402
171 Wellingborough	5,342	801
172 Kettering	4,524	828
173 Thrapston	3,210	480
174 Oundle	3,914	585
175 Peterborough	7,239	1,083
	53,460	7,884

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
11. HUNTINGDON-SHIRE.		
176 Huntingdon	5,225	783
177 St. Ives	5,148	771
178 St. Neots	4,706	705
	15,079	2,259
12. BEDFORDSHIRE.		
179 Bedford	8,880	1,332
180 Biggleswade	5,849	876
181 Ampthill	4,135	618
182 Woburn	3,019	450
183 Leighton Buzzard	4,285	642
184 Luton	6,272	939
	32,450	4,857
13. CAMBRIDGE-SHIRE.		
185 Caxton	2,766	114
186 Chesterton	6,292	942
187 Cambridge	6,954	1,041
188 Linton	3,537	528
189 Newmarket	7,664	1,149
190 Ely	5,724	858
191 North Witchford	4,061	618
192 Whittlesey	1,922	288
193 Wisbeach	9,054	1,356
	47,974	6,894
Total of No. III. Division	306,577	45,795

No. IV. DIVISION.—EASTERN.

Volunteer Force should be 3-20ths of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
14. ESSEX.		
194 West Ham	8,599	1,287
195 Epping	3,908	585
196 Ongar	2,964	444
197 Romford	6,152	921
198 Orsett	2,660	399
199 Billericay	3,447	516
200 Chelmsford	8,068	1,209
201 Rochford	3,959	591
202 Maldon	5,534	828

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
Essex—*continued.*		
203 Tendring	6,927	1,038
204 Colchester	4,861	729
205 Lexden	5,416	810
206 Witham	4,025	603
207 Halstead	4,818	720
208 Braintree	4,390	657
209 Dunmow	5,134	768
210 Saffron Walden	5,179	774
	86,031	12,879

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No. IV. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
15. SUFFOLK.		
211 Risbridge	4,531	678
212 Sudbury	7,703	1,155
213 Cosford	4,527	678
214 Thingoe	4,753	711
215 Bury St. Edmunds	3,475	519
216 Mildenhall	2,588	387
217 Stow	5,277	789
218 Hartismere	4,757	711
219 Hoxne	3,975	594
220 Bosmere	4,305	645
221 Samford	3,123	468
222 Ipswich	8,189	1,227
223 Woodbridge	5,944	891
224 Plomesgate	5,269	804
225 Blything	6,971	1,044
226 Wangford	3,503	525
227 Mutford	5,041	756
	84,031	12,582
16. NORFOLK.		
228 Yarmouth	6,720	1,008
229 Flegg	2,124	318
230 Tunstead	3,903	585
Norfolk—*continued.*		
231 Erpingham	5,430	813
232 Aylsham	5,002	750
233 St. Faith's	2,972	444
234 Norwich	17,049	2,556
235 Forehoe	3,391	507
236 Henstead	2,886	432
237 Blofield	2,893	432
238 Loddon	3,774	564
239 Depwade	6,599	987
240 Guiltcross	3,186	477
241 Wayland	3,035	453
242 Mitford	7,347	1,101
243 Walsingham	5,470	819
244 Docking	4,537	678
245 Freebridge Lynn	3,389	507
246 King's Lynn	5,132	768
247 Downham	5,246	786
248 Swaffham	3,560	537
249 Thetford	4,760	714
	108,425	16,236
Total of No. IV. Division	278,487	41,697

No. V. DIVISION.—SOUTH-WESTERN.

Volunteer Force should be 4-20ths of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
17. WILTSHIRE.		
250 Highworth	4,405	881
251 Cricklade	2,850	570
252 Malmsbury	3,725	745
253 Chippenham	5,352	1,070
254 Calne	2,293	458
255 Marlborough	2,566	513
256 Devizes	5,559	1,111
257 Melksham	4,704	940
258 Bradford	2,902	580
259 Westbury	3,132	626
260 Warminster	4,267	853
261 Pewsey	3,126	625
262 Amesbury	2,062	412
263 Alderbury	3,727	745
264 Salisbury	2,232	446
265 Wilton	2,685	537
266 Tisbury	2,545	509
267 Mere	2,108	421
	60,240	12,042
18. DORSETSHIRE.		
268 Shaftesbury	3,257	651
269 Sturminster	2,595	519
270 Blandford	3,709	741
271 Wimborne	4,321	864
272 Poole	3,222	644
Dorsetshire—*continued.*		
273 Wareham	4,354	870
274 Weymouth	5,509	1,101
275 Dorchester	6,250	1,250
276 Sherborne	3,270	654
277 Beaminster	3,567	713
278 Bridport	4,216	843
	44,270	8,850
19. DEVONSHIRE.		
279 Axminster	5,076	1,015
280 Honiton	5,956	1,191
281 St. Thomas	12,201	2,440
282 Exeter	8,206	1,641
283 Newton Abbot	13,076	2,615
284 Totnes	8,506	1,701
285 Kingsbridge	5,344	1,068
286 Plympton St. Mary	4,931	986
287 Plymouth	13,055	2,611
288 East Stonehouse	2,995	599
289 Stoke Damerel	9,545	1,909
290 Tavistock	6,962	1,392
291 Okehampton	5,100	1,020
292 Crediton	5,432	1,086
293 Tiverton	9,891	1,978
294 South Molton	5,141	1,028

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No. V. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
Devonshire—*continued.*		
295 Barnstaple	9,544	1,908
296 Torrington	4,373	874
297 Bideford	4,902	980
298 Holsworthy	2,845	569
	143,080	28,611
20. CORNWALL.		
299 Stratton	2,145	429
300 Camelford	2,112	422
301 Launceston	4,193	838
302 St. German's	4,136	827
303 Liskeard	8,458	1,691
304 Bodmin	5,123	1,024
305 St. Columb	4,350	870
306 St. Austell	8,018	1,603
307 Truro	10,567	2,113
308 Falmouth	5,513	1,102
309 Helston	7,100	1,420
310 Redruth	13,407	2,681
311 Penzance	13,379	2,675
312 Scilly Islands	657	131
	89,158	17,826

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
21. SOMERSETSHIRE.		
313 Williton	4,974	994
314 Wellington	5,530	1,106
315 Taunton	8,778	1,755
316 Bridgwater	8,297	1,659
317 Langport	4,642	928
318 Chard	6,521	1,304
319 Yeovil	7,116	1,422
320 Wincanton	5,328	1,065
321 Frome	6,331	1,266
322 Shepton Mallet	4,239	847
323 Wells	5,335	1,067
324 Axbridge	8,265	1,653
325 Clutton	6,307	1,261
326 Bath	17,462	3,492
327 Keynsham	5,404	1,080
328 Bedminster	9,536	1,907
	114,065	22,806
Total of No. V. Division	450,813	90,135

No. VI. DIVISION.—WEST MIDLAND.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
22. GLOUCESTERSHIRE.		
329 Bristol	16,429	821
330 Clifton	19,487	974
331 Chipping Sodbury	4,631	231
332 Thornbury	4,113	205
333 Dursley	3,701	185
334 Westbury on Severn	4,531	226
335 Newent	3,144	157
336 Gloucester	8,011	400
337 Wheatenhurst	1,997	99
338 Stroud	9,346	467
339 Tetbury	1,563	78
340 Cirencester	5,332	266
341 Northleach	2,746	137
342 Stow-on-the-Wold	2,483	124
343 Winchcomb	2,534	126
344 Cheltenham	11,046	552
345 Tewkesbury	3,783	189
	104,977	5,237
23. HEREFORDSHIRE.		
346 Ledbury	3,285	164
347 Ross	3,875	193
348 Hereford	8,788	439
349 Weobly	2,179	108
350 Bromyard	2,923	146
351 Leominster	3,727	186
	24,777	1,236

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
24. SHROPSHIRE.		
352 Ludlow	4,263	213
353 Clun	2,530	126
354 Church Stretton	1,542	77
355 Cleobury Mortimer	2,158	107
356 Bridgnorth	3,902	195
357 Shiffnal	2,871	143
358 Madeley	6,907	345
359 Atcham	4,793	239
360 Shrewsbury	5,776	288
361 Oswestry	5,699	284
362 Ellesmere	3,920	196
363 Wem	4,237	211
364 Market Drayton	3,540	177
365 Wellington	5,182	259
366 Newport	3,905	195
	61,225	3,055
25. STAFFORDSHIRE.		
367 Stafford	5,697	284
368 Stone	4,836	241
369 Newcastle-under-Lyme	5,203	260
370 Wolstanton	10,479	523
371 Stoke-upon-Trent	14,485	724
372 Leek	5,758	287
373 Cheadle	4,535	226
374 Uttoxeter	3,785	189
375 Burton-upon-Trent	7,961	398
376 Tamworth	3,499	174
377 Lichfield	6,320	316

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No. VI. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
Staffordshire—*continued.*		
378 Penkridge	4,212	210
379 Wolverhampton	26,039	1,301
380 Walsall	10,761	538
381 West Bromwich	17,432	871
382 Dudley	26,632	1,331
	157,634	7,873
36. WORCESTERSHIRE.		
383 Stourbridge	14,337	716
384 Kidderminster	8,229	411
385 Tenbury	1,762	88
386 Martley	3,453	172
387 Worcester	6,919	345
388 Upton-on-Severn	4,517	225
389 Evesham	3,616	180
390 Pershore	3,388	169
391 Droitwich	4,536	226
392 Bromsgrove	6,205	310
393 Kings Norton	7,718	385
	64,682	3,227

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
37. WARWICKSHIRE.		
394 Birmingham	43,488	2,174
396 Aston	16,713	835
396 Menden	2,817	140
397 Atherstone	2,862	143
398 Nuneaton	3,383	169
399 Foleshill	4,872	243
400 Coventry	9,203	460
401 Rugby	5,869	293
402 Solihull	2,983	149
403 Warwick	10,483	524
404 Stratford-on-Avon	5,197	259
405 Alcester	4,370	218
406 Shipston-on-Stour	5,163	258
407 Southam	2,626	131
	120,029	5,996
Total of No. VI. Division	533,224	26,624

No. VII. DIVISION.—NORTH MIDLAND.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
28. LEICESTERSHIRE.		
408 Lutterworth	4,048	202
409 Market Harborough	3,960	198
410 Billesdon	1,752	87
411 Blaby	3,547	177
412 Hinckley	3,899	194
413 Market Bosworth	3,408	170
414 Ashby-de-la-Zouch	6,474	323
415 Loughborough	6,342	317
416 Barrow-on-Soar	5,015	250
417 Leicester	15,160	758
418 Melton Mowbray	5,133	256
	58,738	2,932
29. RUTLANDSHIRE.		
419 Oakham	2,878	143
420 Uppingham	3,190	160
	6,068	303

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
30. LINCOLNSHIRE.		
421 Stamford	4,939	246
422 Bourn	5,590	279
423 Spalding	5,322	266
424 Holbeach	4,783	239
425 Boston	9,611	480
426 Sleaford	6,138	306
427 Grantham	7,462	373
428 Lincoln	10,515	525
429 Horncastle	6,272	313
430 Spilsby	7,234	361
431 Louth	8,357	417
432 Caistor	8,573	428
433 Glanford Brigg	8,446	422
434 Gainsborough	6,814	340
	100,056	4,995
31. NOTTINGHAMSHIRE.		
435 East Retford	5,689	284
436 Worksop	4,788	239
437 Mansfield	7,536	376
438 Basford	16,231	811
439 Radford	6,694	334
440 Nottingham	14,605	730
441 Southwell	6,404	320
442 Newark	7,587	379
443 Bingham	4,060	203
	73,594	3,676

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No. VII. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
32. DERBYSHIRE.		
444 Shardlow	8,080	404
445 Derby	10,921	546
446 Belper	11,718	585
447 Ashborne	5,233	261
448 Chesterfield	11,449	572
Derbyshire—*continued.*		
449 Bakewell	7,470	373
450 Chapel-en-le-Frith	2,874	143
451 Hayfield	7,428	371
	65,173	3,255
Total of No. VII. Division	303,629	15,161

No. VIII. DIVISION.—NORTH-WESTERN.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
33. CHESHIRE.		
452 Stockport	25,052	1,252
453 Macclesfield	15,832	791
454 Altrincham	8,511	425
455 Runcorn	6,452	322
456 Northwich	7,800	390
457 Congleton	7,628	381
458 Nantwich	9,496	475
459 Great Boughton (Chester)	13,321	666
460 Wirrall	14,289	714
	108,381	5,416
34. LANCASHIRE.		
461 Liverpool	64,509	3,225
462 West Derby	38,319	1,916
463 Prescot	14,018	701
464 Ormskirk	9,577	479
465 Wigan	19,385	969
466 Warrington	9,041	452
467 Leigh	8,183	409
468 Bolton	28,678	1,434
Lancashire—*continued.*		
469 Bury	22,204	1,110
470 Barton-upon-Irwell	7,896	395
471 Chorlton	30,960	1,548
472 Salford	21,881	1,094
473 Manchester	57,108	2,855
474 Ashton-under-Lyne	29,780	1,489
475 Oldham	21,697	1,085
476 Rochdale	18,129	906
477 Haslingden	12,606	630
478 Burnley	15,967	798
479 Clitheroe	5,592	280
480 Blackburn	22,684	1,134
481 Chorley	9,425	471
482 Preston	24,136	1,207
483 Fylde	5,500	275
484 Garstang	3,174	159
485 Lancaster	8,665	433
486 Ulverstone	7,639	382
	516,643	25,836
Total of No. VIII. Division	625,024	31,252

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No. IX. DIVISION.—YORK.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.	COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
35. WEST RIDING.			**36. EAST RIDING (with York City).**		
487 Sedbergh	1,143	57	515 York	14,279	713
488 Settle	3,440	172	516 Pocklington	4,024	201
489 Skipton	7,191	359	517 Howden	3,609	180
490 Pateley Bridge	1,895	94	518 Beverley	5,010	250
491 Ripon	4,662	233	519 Sculcoates	11,180	559
492 Knaresborough	6,946	347	520 Hull	12,667	633
493 Otley	7,161	358	521 Patrington	2,352	117
494 Keighley	11,476	573	522 Skirlaugh	2,320	116
495 Todmorden	7,422	371	523 Driffield	4,566	226
496 Saddleworth	4,450	222	524 Bridlington	3,580	179
497 Huddersfield	30,965	1,548		63,587	3,174
498 Halifax	30,239	1,511			
499 Bradford	45,491	2,274	**37. NORTH RIDING.**		
500 Hunslet	22,170	1,108	525 Scarborough	6,154	307
501 Leeds	25,336	1,266	526 Malton	5,782	289
502 Dewsbury	17,942	897	527 Easingwold	2,862	143
503 Wakefield	12,220	611	528 Thirsk	3,190	159
504 Pontefract	7,484	374	529 Helmsley	3,114	155
504a Hemsworth	2,039	101	530 Pickering	2,494	124
505 Barnsley	8,745	437	531 Whitby	5,398	269
506 Wortley	8,003	400	532 Guisbrough	3,050	152
507 Ecclesall Bierlow	9,478	473	533 Stokesley	2,166	108
508 Sheffield	25,906	1,295	534 Northallerton	3,115	155
509 Rotherham	8,270	413	535 Bedale	2,245	112
510 Doncaster	8,669	433	536 Leyburn	2,514	125
511 Thorne	3,971	198	537 Askrigg	1,409	70
512 Goole	3,421	171	538 Reeth	1,705	85
513 Selby	3,857	192	539 Richmond	3,461	173
514 Tadcaster	4,988	249		43,659	2,426
	335,009	16,737	Total of No. IX. Division	447,255	22,337

No. X. DIVISION.—NORTHERN.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.	COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
38. DURHAM.			**39. NORTHUMBERLAND.**		
540 Darlington	5,404	270	552 Newcastle-upon-Tyne	22,289	1,114
541 Stockton	13,233	661	553 Tynemouth	16,062	803
542 Auckland	7,521	376	554 Castle Ward	3,474	173
543 Teesdale	4,953	247	555 Hexham	7,609	380
544 Weardale	3,642	182	556 Haltwhistle	1,821	91
545 Durham	13,988	699	557 Bellingham	1,638	81
546 Easington	5,449	272	558 Morpeth	4,532	226
547 Houghton-le-Spring	4,891	244	559 Alnwick	5,280	264
548 Chester-le-Street	5,227	261	560 Belford	1,718	86
549 Sunderland	17,644	882	561 Berwick	6,023	301
550 South Shields	8,947	447	562 Glendale	3,587	179
551 Gateshead	12,020	601	563 Rothbury	1,858	92
	102,919	5,142		75,891	3,790

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No. X. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
40. CUMBERLAND.		
564 Alston	1,704	85
565 Penrith	5,577	278
566 Brampton	2,831	141
567 Longtown	2,424	121
568 Carlisle	10,389	519
569 Wigton	5,915	295
570 Cockermouth	9,627	481
571 Whitehaven	8,903	445
572 Bootle	1,502	75
	48,872	2,440
41. WESTMORELAND.		
573 East Ward	3,415	170
574 West Ward	2,039	101
575 Kendal	9,143	457
	14,597	728
Total of No. X. Division	243,279	12,100

No. XI. OR WELSH DIVISION.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
42. MONMOUTHSHIRE.		
576 Chepstow	4,764	238
577 Monmouth	6,845	342
578 Abergavenny	14,807	740
579 Pontypool	6,998	350
580 Newport	10,868	543
	44,282	2,213
43. SOUTH WALES.		
Glamorganshire.		
581 Cardiff	11,623	581
582 Merthyr Tydfil	19,201	960
583 Bridgend	5,855	292
584 Neath	11,618	580
585 Swansea	11,727	586
	60,024	2,999
Carmarthenshire.		
586 Llanelly	5,877	293
587 Llandovery	3,764	188
588 Llandilofaur	4,492	224
589 Carmarthen	9,535	476
	23,668	1,181
Pembrokeshire.		
590 Narberth	5,532	276
591 Pembroke	5,740	287
592 Haverfordwest	9,845	492
	21,117	1,055
Cardiganshire.		
593 Cardigan	5,046	252
594 Newcastle-in-Emlyn	5,043	252
595 Lampeter	2,468	123
596 Aberayron	3,306	165
597 Aberystwith	5,938	296
598 Tregaron	2,601	130
	24,402	1,218
Brecknockshire.		
599 Builth	2,086	104
600 Brecknock	4,543	227
601 Crickhowell	5,424	271
602 Hay	2,740	137
	14,793	739
Radnorshire.		
603 Presteigne	3,787	189
604 Knighton	2,370	118
605 Rhayader	1,699	84
	7,856	391
44. SOUTH WALES.		
Montgomeryshire.		
606 Machynlleth	3,024	151
607 Newtown	6,277	313
608 Montgomery	5,095	254
609 Llanfyllin	4,884	244
	19,280	962
Flintshire.		
610 Holywell	10,361	513
Denbighshire.		
611 Wrexham	10,574	528
612 Ruthin	4,213	210
613 St. Asaph	6,322	316
614 Llanrwst	3,119	155
	24,228	1,209
Merionethshire.		
615 Corwen	3,884	192
616 Bala	1,684	84
617 Dolgelly	3,243	162
618 Festiniog	4,045	202
	12,826	640
Carnarvonshire.		
619 Pwllheli	5,447	272
620 Carnarvon	7,611	380
621 Bangor	7,702	385
622 Conway	2,907	145
	23,667	1,182
Anglesey.		
623 Anglesey	10,811	540
Total of No. XI. Division	297,095	14,842

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No. XII. OR SCOTCH DIVISION.

Volunteer Force should be 1-20th of Males capable of bearing Arms.

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
SOUTHERN COUNTIES.		
Dumfries.		
625 Eskdale	1,959	98
626 Annandale	8,785	439
627 Nithsdale	8,787	439
	19,531	976
Kirkcudbright.		
628 East Kirkcudbright	7,551	378
629 West Kirkcudbright	3,230	162
	10,781	540
Wigtown.		
630 Wigtown	10,847	542
Ayrshire.		
631 Carrick	7,823	391
632 Kyle	18,071	903
633 Cunninghame	21,568	1,078
	47,462	2,372
Buteshire.		
634 Arran	1,487	74
635 Bute	2,665	133
	4,152	207
Renfrewshire.		
636 Renfrew, Lower	12,218	611
637 Renfrew, Upper	28,055	1,403
	40,273	2,014
Dumbarton.		
638 Dumbarton	11,276	564
Lanarkshire.		
639 Glasgow City	86,247	4,312
640 Lanark, Lower	6,453	323
641 Lanark, Middle	29,777	1,489
642 Lanark, Upper	10,067	503
	134,544	6,627
Stirling.		
643 Stirling	21,559	1,078
Linlithgow.		
644 Linlithgow	7,534	377
Edinburghshire.		
645 Edinburgh, West	5,113	256
646 Edinburgh, City	48,482	2,424
647 Edinburgh, East	11,264	563
	64,859	3,243
Peebleshire.		
648 Peebles	2,685	134
Selkirkshire.		
649 Selkirk	2,452	123
Roxburghshire.		
650 Hawick	4,024	201
651 Melrose	2,690	135
652 Jedburgh	2,560	128
653 Kelso	3,637	182
	12,911	646
Berwickshire.		
654 Berwick	9,074	454
Haddington.		
655 Haddington	9,097	454
Fifeshire.		
656 St. Andrew's	8,019	401
657 Cupar	8,608	430
658 Kirkcaldy	12,955	648
659 Dunfermline	8,805	440
	38,387	1,919
Kinross-shire.		
660 Kinross	2,231	112
Clackmannan.		
661 Clackmannan	5,738	287
NORTHERN COUNTIES.		
Perthshire.		
662 Perth, West	5,246	263
663 Perth, East	23,861	1,193
664 Perth, City	5,558	278
	34,665	1,734
Forfarshire.		
665 Dundee	23,815	1,191
666 Forfar	24,001	1,200
	47,816	2,391
Kincardine.		
667 Kincardine	8,649	432
Aberdeenshire.		
668 Aberdeen	21,565	1,078
669 Kincardine O'Neil	3,985	199
670 Alford	3,166	158
671 Strathbogie	2,577	129
672 Garioch	4,537	227
673 Ellon	3,844	192
674 Deer, or Buchan	9,736	486
675 Turriff	3,598	180
	53,008	2,649
Banff.		
676 Banff	13,543	677
Elgin.		
677 Elgin	9,739	487

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No. XII. DIVISION—*continued.*

COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
Nairn.		
678 Nairn . . .	2,489	124
Inverness.		
679 Inverness, East .	9,652	482
680 Inverness, West .	4,670	233
681 Inverness Islands .	9,803	490
	24,125	1,205
Argyleshire.		
682 Argyle . . .	4,305	215
683 Islay	3,975	199
684 Kintyre . . .	4,479	224
685 Cowal . . .	2,234	112
686 Lorn	3,534	176
687 Mull	3,797	190
	22,324	1,116
Ross and Cromarty.		
688 Lewis . . .	4,928	247
689 Ross, Wester . .	10,132	507
690 Ross, Easter . .	5,617	281
	20,677	1,035
Sutherland.		
691 Sutherland . .	6,448	323
Caithness.		
692 Caithness . . .	9,677	484
Orkney Islands.		
693 South Isles, Orkney .	1,342	67
694 Mainland, Orkney .	4,189	209
695 North Isles, Orkney .	2,332	117
696 Shetland Isles . .	7,769	389
	15,632	782
Total of No. XII. Division	722,185	36,108

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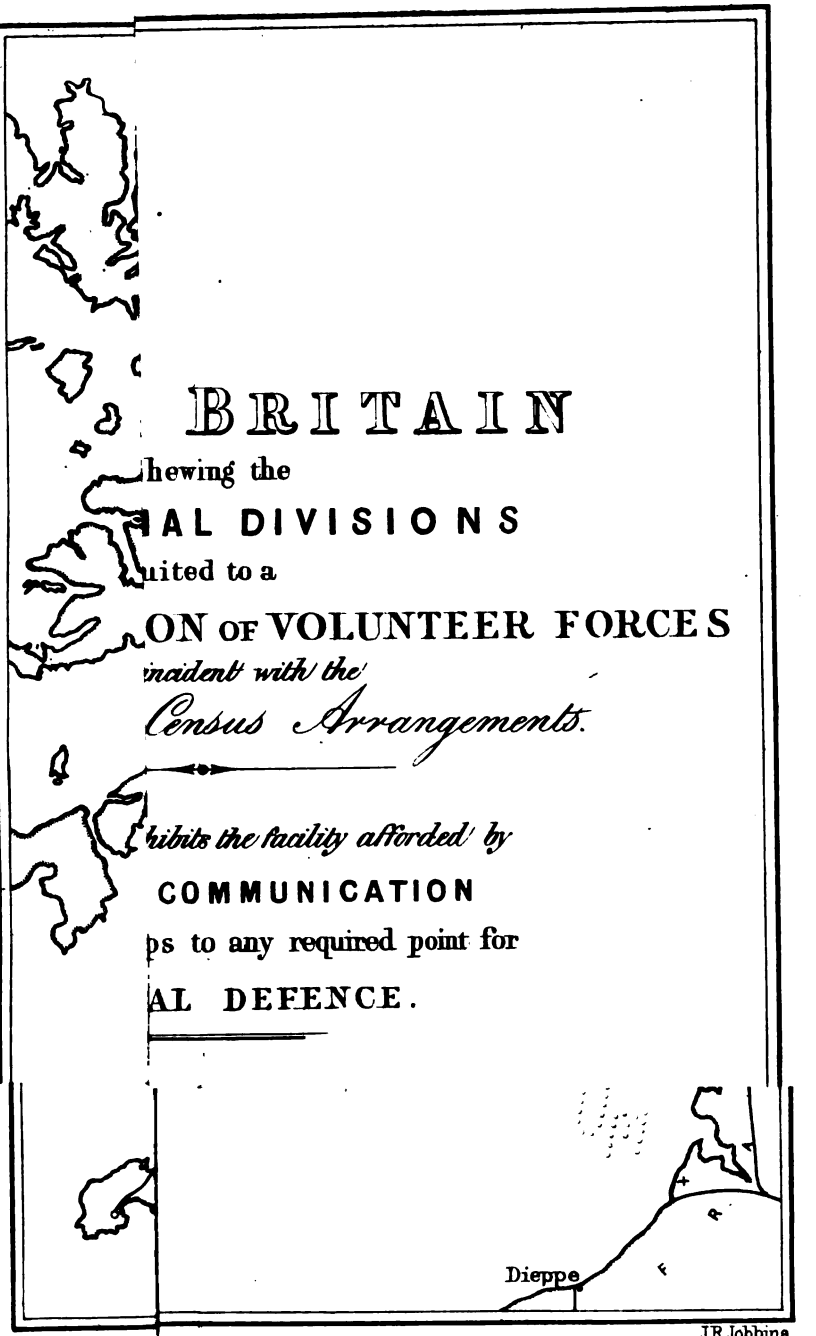

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Friday, March 23rd, 1860.

Sir SIBBALD SCOTT, BART. in the Chair.

A SCHEME FOR THE RE-ORGANIZATION, RECRUITING, AND INSTRUCTION OF THE ARMY.

Prepared by an Officer of Rank, and read by Colonel the Hon. JAMES LINDSAY, M.P.

PUBLIC attention has been for the last six years directed in a favourable manner towards the Army. The brilliant victories in the Crimea, and the calm endurance exhibited throughout that campaign; the splendid triumphs in India, and the dauntless heroism displayed in the suppression of the mutiny and rebellion, have had the effect of raising the character of the Army in the estimation of the country—which, owing to a long peace of 40 years' duration, broken only by occasional campaigns in India and at the Cape, did not receive that appreciation to which it was justly entitled.

For the first time since the Restoration, the Army is looked upon without fear and distrust. Even during the triumphant progress of the Peninsular War, statesmen were found ready to depreciate our Army, and to declaim against any attempt to raise a military spirit in the nation; now, however, the old cry that a standing Army, controlled by the provisions of an annual mutiny act, is dangerous to the liberties of the country, seems entirely exploded; and the necessity of retaining in the realm an adequate force to defend our shores, and an Army, as perfect in all its departments and matériel as can be obtained in peace, is now distinctly recognised.

Though great progress has been recently made towards the attainment of this object, and the position of the soldier has been much improved, yet it is necessary still further to increase the attraction of the profession, and so to organise the force as to make it as disposable and available as the foreign policy of the Government and the vast territorial dependencies of the Crown may require, and as efficient as professional instruction can render it.

For two centuries it has been the constant habit of this country, in its jealousy of a standing Army, to keep forces in time of peace barely sufficient to relieve troops stationed in the colonies. Large forces were raised for special emergencies, and as soon as the object which called them into existence had passed, they were reduced, both for the above reason and for the sake of temporary economy. The ruinous consequence of this policy is now a matter of history. War has always been commenced with an army utterly disproportioned to the object in view—without

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reserves, with soldiers suddenly raised, and consequently inferior in discipline; and it has usually required the experience of a few years campaigning before England's Army appears in the field as in the days of Marlborough and Wellington, unrivalled in discipline and unsurpassed in organization. But no sooner has peace been proclaimed than the cry for reduction is raised; and, though it cannot be expected that a war establishment should be maintained in peace, yet reduction has generally been carried to a point so low as to paralyse the power of the nation, and provide troops no more than sufficient for colonial reliefs.

The following passage, from the writings of Dean Tucker, illustrates in forcible language the course of policy which has heretofore prevailed as regards the Army.

"The *Patriot* and furious *Anti-Courtier* loudly exclaims against even a small Parliamentary Army, both on account of its danger and expense. By persevering in these laudable endeavours he prevents such a number of forces being kept up as are necessary for the common safety of the kingdom. The consequence is, when a war breaks out, new levies are half-formed and half-disciplined, and the officers novices in their business. Thus the nation is involved in expenses ten times as great, and made to raise forces twenty times as numerous as were complained of before; till peace is made and schemes of ruinous economy are again called for by a new set of patriots. Thus the patriotic farce goes round, ending in a real tragedy to the nation and mankind."

It will be within the immediate recollection of every one, that when war broke out in 1854 with Russia, 10,000 men were ordered to Malta, and in order to make up the regiments composing this force, volunteers were called for from regiments remaining at home; shortly after 10,000 additional men were ordered to Turkey, when the regiments that had already parted with their best men were compelled to call for volunteers from the few regiments that were to be left at home, and to fill up their ranks with raw recruits. There was no reserve left. The men sent out to fill up the chasms caused by action and disease, and the regiments subsequently ordered to the Crimea, were, with one or two exceptions, nothing better than recruits, who were, to use the expression of Lord Raglan, "swept away like flies."

Such have been the results during a long course of years of the want of preparation for emergencies which characterised the policy that has been pursued with regard to the army, and it behoves us in the present disturbed state of Europe, and the uncertain position of our relations with foreign powers, to consider if some improvement could be introduced into our military system. It is therefore proposed to show,—

1st. That the nation can be attacked, and that the Channel can be bridged.

2nd. That the organization of the Army is defective, both in numerical amount and distribution.

3rd. That great improvements can be carried out in the distribution, recruiting, and instruction of the Army.

The Possibility of Invasion.

The formidable forces permanently at the disposal of the Emperor of the French, Cherbourg and its capacity for mischief, and the successful issue of the Emperor's rapid aggressive operations in Italy, having pro-

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duced a salutary alarm and distrust, and confirmed the opinion of able officers, that the command of the Channel may be obtained by our warlike neighbours, and that it is possible, with a free sea, for 200,000 organised disciplined troops to effect a hostile landing on the assailable shores of England, the real and positive danger which may still continue to embarrass and beset us will be precisely comprehended by an attentive consideration of the note which General Buonaparte transmitted to the Directory, dated Paris, 13 April, 1798, "relating to the system of war that ought to be pursued against England."

Napoleon's Plan for Invasion in 1798.

From the following extract from this remarkable document, we may imagine the advice offered to the Directory has not altogether escaped the notice of Louis Napoleon.

"Dans notre position, nous devons faire à l'Angleterre une guerre sure, et nous le pouvons.

Que nous soyons en paix ou en guerre, il nous faut 40 ou 50 millions pour réorganiser notre marine.

Notre armée de terre n'en sera ni plus ni moins forte ; au lieu que la guerre oblige l'Angleterre à faire des preparatifs immenses qui ruinent ses finances, détruisent l'esprit de commerce, et changent absolument la constitution et les mœurs de ce peuple.

Nous devons employer tout l'été à armer notre escadre de Brest, à faire exercer nos matelots dans la rade, à achever les vaisseaux qui sont en construction à Rochefort, à Lorient, et à Brest.

Si l'on met quelque activité dans ces travaux, nous pouvons espérer d'avoir au mois de Septembre trente-cinq vaisseaux à Brest, y compris les quatre ou cinq nouveaux que l'on peut construire à Lorient et à Rochefort.

Nous aurons vers la fin du mois, dans les différens ports de la Manche, pres de 200 chaloupes canonnières. Il faut les placer à Cherbourg, au Havre, à Boulogne, à Dunkerque et à Ostende, et employer tout l'été à emmariner nos soldats.

En continuant à donner à la commission des côtes de la Manche 8 millions par mois, nous pouvons faire construire 200 autres chaloupes d'une dimensions plus forte, et propres à transporter des chevaux.

Nous aurions donc, au mois de Septembre, 400 chaloupes canonnières à Boulogne, et 35 vaisseaux de guerre à Brest. Les Hollandais peuvent également avoir dans cet intervalle 12 vaisseaux de guerre au Texel.

* * * * * * *

Il serait possible alors de transporter 40 mille hommes sur le point de l'Angleterre que l'on voudrait, évitant même un combat naval si l'ennemi était plus fort, tandis que 40 mille hommes menaceraient de partir sur les 400 chaloupes canonnières et autant des bateaux pêcheurs de Boulogne, et que l'escadre Hollandais, avec 10 mille hommes de transport, menacerait de se porter en Ecosse.

L'invasion en Angleterre, exécutée de cette manière, et dans le mois de Novembre et de Decembre, serait presque certaine.

L'Angleterre s'épuiserait par un effort immense et qui ne la garantirait pas de notre invasion."

Means of Resistance and Composition of our Forces.

The above may assist us, during this temporary lull, which is dependant on the management of Louis Napoleon, and before a peace establishment suited to the times may be determined on, in calculating the means and power of the nation to resist attack, in examining closely the composition of our forces, improving our military constitution, and in judging how far the defensive measures proposed are adequate to the supposed crisis. Commissions on our national defences have been appointed, forts and towers have been armed, positions for reserved arsenals have been selected,

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every creek and accessible inlet has been repeatedly surveyed. The principal fortresses and dockyards are being extensively enlarged and improved. The Volunteer Rifle Movement has been enthusiastically and opportunely encouraged. The divisions, and brigades, and regiments are models of discipline, and are in themselves as perfect as they can be made by vigilant instruction, elementary drill, rifle practice, and incessant tactical display; but the battalions destined to bear the brunt, and to be first and foremost in the fight, and to give example and confidence when arranged and united to Militia, Yeomanry, and organised Rifle Volunteers; the troops by which the whole defensive machinery is to be brought into use and worked, are so deplorably below the mark in respect to numbers, that it is inconceivable in this age of reform, that the distribution and formative regimental organisation of the Infantry of the Line should not yet have been constituted on solid principles, applicable to every description of service, and embracing the ultimate purposes of depôts unembarrassed by provisional battalions, and the waste of force resulting from their restrictive duties.

The organic reforms to which we advert, and which we think necessary, could not fail to aid in planting firmly a precautionary system of defence, advancing the interior and exterior political interests of this country, and in sustaining without difficulty the required reliefs of corps in India.

Recruiting.

Voluntary enlistment, a mode of recruiting peculiarly suited to the British Army, and the only one adapted to our institutions, should be rendered so attractive, that it might be composed of the best of the working classes, and raised in character and usefulness far above any other European force.

Effect of the Military Constitution.

A military constitution found to be so ruinously defective, that it will not admit of extensive or important offensive operations being carried on, or the interests of colonies protected, without exposing the parent state to insult or invasion, must increase the public expenditure desired to be avoided by temporary arrangements necessarily sanctioned in such a case. The organisation of our Army constantly produces such results.

A Kaffir war draws a force from our shores not disposable, Russian menaces denude our colonies, and, the Crimean services terminated, a formidable mutiny requires that the Militia should suddenly be called out to replace the troops on passage to India. A more uneconomical system could not have been devised, or one more injuriously affecting the discipline of regiments, than that which it appears from the annual estimates will continue to be followed.

Impracticable as it would be to guard against such shocks as these, or to be prepared at all times for the calamitous consequences inseparable from the control and management of vast territorial acquisitions, yet the permanent forces of the empire might be augmented and distributed so judiciously, and adapted to a defensive position, quasi belligerent, that the endless excessive outlay created by transitions from inconsiderate and

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absurd reductions to extraordinary exertion and exhausting efforts, and occasioned by raising new regiments and concentrating scattered troops for immediate action and unexpected warfare, might never be demanded.

Effect of the Depôt Battalion System. Proposed Organic Change.

The active battalions of the regular Army at home may be estimated at present at 29,800 rank and file; viz. 5,800 Foot Guards, 24,000 or 30 battalions of Infantry of the Line. To this slender statement may be added 24 depôt provisional battalions, amounting perhaps occasionally to 23,000 rank and file. These, however, from their construction and abrupt fluctuations in numbers and restrictive local duties can scarcely be called moveable for field service. They are in every respect inferior to service companies of regiments, and have not the advantages derived from *esprit de corps*. They are liable to an oppressive accumulation of the youngest of young officers, beyond the influential control of their own commanding officers, which must be unfavourable to strict discipline; they absorb nearly half the force of the Infantry of the Line stationed at home, in carrying on a preparatory and limited course of drill for recruits, to fit them for embarkation, which could be accomplished, and many other important objects secured, by adopting *permanently* the organic formation of regiments with two battalions, each applicable to unlimited service, *one* to be in its turn, as a general regulation, retained at home with the functions of a recruiting depôt, while the other is serving abroad, and both at the disposal of the War Department on urgent occasions.

It cannot be denied, however, that as a mere depôt for drilling and distributing recruits, and for the reception of soldiers whose cases will not admit of service abroad, the establishment of Provisional Depôt Battalions works smoothly, and the process of regulating reinforcements and drafts for embarkation and conveyance to colonial territories is carried on with wonderful continuity and exactitude. But although such depôts might be necessary for a large continental Army raised by conscription, the continuance of the existing depôt system would interfere with the efficiency of the Volunteer Regular Army.

The establishment of every regiment at home should be raised as soon as possible to 1,400 rank and file; and, on reaching that strength, divided into two battalions, and the system of two battalions gradually carried into effect as a permanent organization.

It has been computed, accurately we believe, that we are losing men at the rate of 11,000 a year by desertion—a loss to the country of at least 300,000*l.* per annum.

The whole bounty money given to recruits is a waste of nearly 200,000*l.* per annum, and the whole process of the system disgraceful. Under such circumstances it would be inexcusable in any war department tolerating a mode of raising recruits for our Army, without making every effort to obtain the abolition of a system, believed to be based on falsehood, and directly tending to immorality.

It has been proposed, we observe, in an augmentative memorandum originating in the War Department, to increase the soldier's pay, and to

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place it to his credit when he receives his discharge, and to shorten his term of service; and that to meet the expenses of this increase of pay the public should be released from the following charges:

1. Reduction of the pension list altogether, except in a case of a wound.
2. The abolition of bounty.
3. The diminution of desertion, by which we are losing 11,000 men a year.

By these reforms and others, the public would gain, it is supposed, about 1,500,000*l.*; the increase proposed in the project to which we advert is one shilling per day, which, at the end of a certain term of service, would amount to a large sum, which sum the discharged soldier would be entitled to have paid to him unconditionally.

The whole proposed innovation is excellent in principle, but would not, we think, obtain the approbation required to carry it through as a financial measure. We entertain no doubt that a modified scheme might be most satisfactorily introduced, and completed with the same object, viz.:

Voluntary enlistment for ten years to be continued under a stipulated condition that every soldier, after serving with good conduct for that period, should be entitled to an annuity or pension, calculated on one shilling per diem, and also a gratuity, with the option of continuing his service for seven years more, and all bounties and other pensions to be discontinued.

We may quote some of the leading objections to the present recruiting system as specified in the memorandum to which we refer.

That we do not get men enough; we do not get men of the right sort; and those whom we do get, are not got in a satisfactory manner; they are generally speaking inveigled into enlisting; that it is possible not only to raise a sufficient number by voluntary recruitment, but to make the service so attractive that it will secure the best of the working classes.

It is certain that there are more valid objections to either increased bounty or increased pay than the public expense it would occasion. High bounty leads to desertion, and both one and the other lead to drunkenness and riotous living.

With the inducements proposed to be held out, and the opportunity of enabling a young man at an early age to work out his independance, it is supposed that the recruiting serjeant would soon lose his avocation, and that the difficulty would not be to entice, but to choose among candidates.

Necessary Strength of the Military Force (Infantry) for all Purposes.

At the outbreak in India, the whole of the European troops in the three Presidencies did not exceed 45,500, viz: 24,336 in Bengal; 10,720 in Madras; 10,430 in Bombay.

Whatever may be the force now required for India under present circumstances, we could not calculate on less than 55,000 Infantry of the Queen's Army, exclusive of European corps considered necessary to act with them, under the immediate command of the Governor-General, being retained in the Presidencies for the military occupation of the country, nor less than 24,000 men being required for garrisons abroad and the colonies; 73,000 Infantry of the Line should constitute the regular force, with 5,600 foot guards to be maintained for the defence of the United Kingdom and Ireland, and for reliefs in India. If these forces were organized and

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distributed with ability and economy, it would place at the disposal of the Queen's Government about 145 battalions of the Line, exclusive of troops serving in India, for colonial and home service, at the expense of about 2,500,000*l.* from which would be deducted the charges to be paid by the East Indian Exchequer at about 20,000*l.* for the maintenance of two companies of each battalion of the fifty-five at home.

The results of this construction of the regiments of the Line would prove.

1st. That battalions in serving in the East Indies and distant colonies might be relieved every ten years punctually, and every six years in colonies nearer home.

2nd. That Volunteer Rifle Corps could be united and efficiently attached to 15 or 26 divisions, composed of soldiers of the regular Army.

3rd. That a sufficient force would always be ready to embark on any emergency for foreign service without being compelled to continue that practice, destructive to regimental discipline, of collecting volunteers from battalions that remain on home service.

With the improved means of transport to India, it would be very desirable that every battalion in India should be relieved when it should be found unfit for active service by sickness or loss in battle; and that every corps should be relieved after nine years' service in India. This system would prove less expensive than reinforcing corps continually with drafts of recruits.

With reference to the Army estimates, it should be borne in mind that in the charges brought forward this year are included alterations and improvements which should have been authorised many years ago. These have been occasioned by improvident reductions, neglect in fortifying dockyards and arsenals, building barracks, repairing and ventilating them since the value of a soldier's health has been understood, and for pensions to invalids discharged in garrisons of an army too limited for their work, and for new armies and armaments.

The commissariat and military train and medical departments have been resuscitated, and greatly improved barracks have been built.

Recapitulation of Advantages in Proposed Scheme.

"We get," says Mr. Sidney Herbert, "our men with *difficulty*, by every kind of cajoling and inducements we can devise, and in our necessity descend to those means which men do not have recourse to till they think all others are exhausted."

Could we imagine this detestable scheme of recruiting the ranks of the Army totally abolished, that young men of the labouring classes of 18 years were able to work out their independence in ten years, and that organic charges in the method of raising recruits had been effected;—

Could we imagine that all battalions at home were carefully distributed and fully occupied on garrison duty, or in the temporary barracks or encampments, or permanent barracks of instruction; and that in the drill season, *for four months*, but never more than *five*, were formed into corps d'armée, and assembled in encampments, as an established regulation; and tactically, strategically, and scientifically instructed and moved; could we imagine that when that tactical and strategical course had terminated,

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and tents struck, the encampment would break up annually in October, and that their battalions would be marched to good permanent or temporary well-ventilated barracks, with drill grounds and ranges for rifle practice, and artillery practice if possible, where they would remain under the immediate command and careful instruction of their own commanding officers, and were inspected, but not too often, by their district brigadiers, or by colonels on the staff, and the recruits with this system carefully trained by elementary tactics for advanced service with their corps; and that every company were instructed in artillery practice, and as staff corps or sappers and miners are taught;—

Could we imagine that all officers appointed to their first commissions, after their examination, were, by this revised system proposed, ordered and compelled to join their *battalions at home* (which should be designated reserved battalions to distinguish them from battalions abroad), and required to go through a course of instruction, before they could succeed to a lieutenantcy, which would qualify them for their duties as regimental officers, and to hold staff situations, in fact to complete their military education under able professors; and that mathematical masters and professors of fortification and drawing masters were attached to each corps at home, or to each district, and that young officers were kept steadily at work under them, and with practical instruction also, turned out and reported tolerable engineers and artillerists after being closely and constantly employed for a year or eighteen months, and that able and accomplished staff college officers, and officers of artillery and engineers who could not find active employment were offered the appointments of instructors;—

Could we imagine that young officers thus educated, and indeed all regimental officers, were to pass an examination for a degree at Sandhurst, and that their examinations were recorded if successful, and noted for promotion by staff employment, and that by this system the military authorities and active general officers employed could have the widest field possible from which officers could be selected for the staff, instead of receiving them from any special staff corps, composed probably of accomplished officers and first-rate disciplinarians, but without military qualification requisite to entitle them to join the staff of an army at the commencement of the operations of an active campaign;—

We would exclaim enthusiastically, could we imagine these essential reforms and revisions effected, that the realization of such benefit to the army would confer lasting honour on the country, and raise the profession and character of a British soldier so highly, that no sum in the annual estimates would be considered extravagant to perfect the beneficial arrangements recommended for adoption.

Primary Examination.

While we endeavour to bring under patient discussion the important questions to which these observations refer, the subject of primary examination for commissions established on the principles recommended by the Duke of Wellington, and of military education and professional training, to which Mr. Sidney Herbert directed the attention of Government in his speech of 5th of June, 1857, since published with an

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appendix, are of such intense interest, that we cannot refrain from offering on opinion that no opportunity should be lost in giving them most attentive consideration.

If the test for admission to the Army were so modified and regulated that candidates would never be hurried from a public school, half educated, to be forced through the process of cramming, but limited to examination prescribed as indispensible and preparatory, to enable them to commence an educational course strictly professional and mathematical the moment they joined their respective reserve battalions at home, their appointments to their first commisions would be free from the difficulties and objections which many officers have noticed who have devoted their time to this question. The second examination at present directed by the Regulations comprehends merely a summary of routine regimental duties, which, in every regiment well composed and commanded, was always insisted on.

But it may be inferred, from the remarks of Mr. Sidney Herbert, that he attributes our reverses in war to a military system unaided by a sound practical education for officers, to executive tactical errors, rather than to ill-considered plans and strategical combinations. Whatever reliance may be placed in these assertions, we are much indebted to him for his continual exertions on behalf of the soldier, and for stimulating the Government to raise the character of the British Army. Every officer will be interested in the great work of introducing a beneficial and extensive system of instruction, and ardently desire that it should be carried further even in detail and method than he has suggested; so that all intelligent officers desirous of improving themselves should have every encouragement and the best opportunity of qualifying themselves to hold staff appointments; and that none should be exempted or excluded from the course proposed to be established.

The grand objects to attain are to get rid of *for ever* the dissolute and idle habits and want of occupation and full employment at depôts, and to change altogether the constitution in regard to "tactique elementaire et grand tactique." Compare the routine depôt system with the activity which would prevail if this new school instruction once opened, where would be studied under able professors, energetically supported by commanding officers—*practical* mechanics, military drawing, sketching, surveying on the ground, sappers and miners, gunnery, throwing up forts, works, pontooning, military topography, reports on roads, and on ground for military positions. Reconnaissances, including an inquiry and report of the resources of the country. Contemplate the beneficial change in prospect which would form a perfect soldier. Habitually accustomed to every kind of military labour, obedient, disciplined, and convert him into a useful civilian after he had reached the independence at an early age to which he would be entitled by the new system of recruiting.

In continental armies, the previous education of officers adopted at military institutions has seldom been found to qualify them properly for the staff.

The military constitution which is advocated in this paper would more contribute to develope the pretensions and qualifications of officers for high and confidential employment than any other system.

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We find that the situation of Brigade Major is always filled by able and active officers, in every respect fit for the duties they have to discharge, because they are selected generally by commanding officers, under whose vigilant inspection they have risen to a certain rank, and established a character in their regiments. It was asserted by a general of great reputation that *fighting, and a good deal of it*, could only make good officers. This, to some extent, may be received as an axiom; we must, however, consult *Guibert*, who persuades us that great generals are rarely to be made or found, and to conclude that none of the capacity described by him can start up in one campaign.

"C'est une encyclopédie, elle seule, que la science militaire. C'est le plus interessants des sciences, soit qu'on la considère relativement à la variété de ses détails, ou à l'importance de son objet, ou la gloire èt aux grands intérêts qui y tiennent. Puisse cette vérité, sentié par les hommes qui sont destinés à commander les armées, leur faire appercevoir l'immensité de leurs obligations! Car ce n'est encore rien, que l'acquisition des connaissances qui composent la science militaire; il faut, pour être un général du premier ordre, savoir employer ces connaissances; il faut avoir le génie que rien ne peut acquérir, le coup-d'œil que l'habitude perfectionne et ne peut donner; il faut réunir un assemblage plus qu' humain de qualités physiques et morales. Aussi doit-on rester confondu d'étonnement et de respect, à la vue de petit nombre de generaux que le posterité honore du nom de grand. Il semble que le nature ne les produise çà et là, au milieu des siecles, que pour servir d'epoques à la grandeur de l'esprit humain."

Hygienne.

With respect to the Hygienne Statistics of Mr. Sidney Herbert they may be correct, but few officers will concur with him when comparing mortality connected with different avocations, that either food, bad cookery, clothing, or ill-ventilated barracks are the *chief* causes of the excessive mortality of the soldiers of the Guards and Line.

A young lad of the Guards probably is on guard twice a-week, and on sentry two hours at a time, four times in the twenty-four hours; and after being exposed to the weather and the currents of the avenues of St. James's returns to a hot guard-room, throwing himself with his damp clothes on a guard-room bed. It is this kind of work, and the want of continuous uninterrupted sleep, the temptations of a capital, habitual inebriety, in fact, the life of a soldier, night duty, and inadequate garrisons, that destroy our soldiers and increase the Pension List.

Barracks are too crowded, and seldom sufficiently ventilated; but the rooms and cottages of our labouring classes are poisonous, in consequence of defective ventilation and cleanliness, in comparison with Barrack accommodation.

The wear and tear of the constitution of the Metropolitan Police do not support the conclusions arrived at in the statistics to which we allude. The stout well-fed Policeman takes his eight hours walk, has ten hours off duty, and a comfortable home ready for his reception when relieved. Positive and accurate information relative to the averages of mortality, and causes of discharges in regiments of the Line, must be difficult to procure. Rapid embarkation, unhealthy stations, and the consequent ill-health, and discharges from the effects of a disease *unnoticed* in the controversial and statistical details lately produced, defy all calculations of the

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Actuary, and the great increase also in the list of discharged, narrow-breasted, ill-formed young soldiers incautiously enlisted from the Militia.

Militia.

The Enrolled English Militia may be stated at 60,000, but not more than 20,000 of this number can be calculated on as an effective force when called out. Unsound and defective as the Militia system is, it might become less objectionable by discontinuing to enlist for the Line when a corps is embodied and called out for permanent duty, and when a regiment has attained a fair state of discipline. If called out for drill, or for inspection, the men might be allowed to volunteer, at any time, with the sanction of their Colonel, while regiments remained disembodied.

Expense.

It might not be thought possible to commence, at this time, with reference to the Navy and Army estimates of this year, the projected reconstruction of regiments of the Line, and the organic change in recruiting which is to attract to the Army the best description of recruits. We have no doubt, however, that these beneficial and necessary measures might be carried into effect *immediately*, without an outlay beyond that included in the estimate of this year; and that, brought forward with the support and concurrence of the Secretary of State for the War Department, and the Commander-in-Chief of the Queen's Army, the Service would derive from them more advantage than from any of the boons which have recently been conferred by their intervention and exertions.

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Evening Meeting.

January 30th, 1860.

W. STIRLING LACON, Esq., in the Chair.

NAMES of MEMBERS who have joined the INSTITUTION since 1st January, 1860.

LIFE.

Somerset, His Grace the Duke of, First Lord of the Admiralty
Layard, C. E., Lieut. 15th Regt.

ANNUAL.

Davies, John, Captain R.N.
Lee, Mainwaring C. W., Lieut. Coldm. Gds.
Buckland, F. T., Asst. Surg. 2nd Life Guards, M.A.
Mayne, Richard C., Lieut. R.N.
Howison, Young Howison, Surg. M.D., Royal Hospital, Chelsea
Leahy, Arthur, Bt. Major R.E.
Doull, Alexander, Lieut. R.A.
Kirk, James B., Capt. 96th Regt. Brigade Major, Devonport
German, James, Capt. 3rd Rl. Lancash. Mil.
Plasket, W. A. H., Lieut. 24th Regt.
Drummond, Edgar A., Lieut. late R.N.
McLaughlin, E., Lieut. Royal Artillery
Porter, Whitworth, Major R.E.
Duff, James, Bt. Major late 23rd R. W. Fus.
Hay, Graham, Capt. 62nd Regiment
Wyatt, John, Asst. Surg. Coldstrm. Guards
Bannister, C. W., Major 2nd Bom. Light Cavalry
Longmore, Thos., Dep. Insp. Gen. of Hosps.
Smith, H. Fowler, M.D., Staff Surgeon
Lemon, Thos., Col. C.B. Roy. Marine Lt. Inf.
Sladen, Joseph, Lieut. Royal Artillery
Chamberlain, W. C., Capt. Royal Navy
Windus, A. J., Lieut. H. M. Indian Navy
Norman, C. W. J., Major 72nd Highlanders
Roberts, C. P., Lieut. Bom. Horse Artillery
Ind, F. J. N., Capt. 37th Regt.
Gourley, de la Chernon, Asst. Surg. late H.E.I.C.
Grant, J. W., Surg. ret. Beng. Army
Minchen, F. C., Lt.-Col. H.M. Indian Army
Dundas, Thos., Capt. 12th Regt.
Rough, Wm. H., Capt. H. A. Company
Gould, T. T., Lieut. 13th Light Infantry
Jones, Geo. Captain, late Mon. Mil.

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Fourteen Stereoscopic Slides of the Franklin Relics. 1 large Photograph of "The Record" in the Museum of the Royal United Service Institution. *Presented by Lieut. Cheyne, R.N.*

MUSEUM.

Military.

Elongated Rifle Bullet, with Cork Belt. Steel Rifle Bolt, with Wooden Jacket. *Presented by Capt. J. Norton.*

Naval.

Model of Native Indian Boat with Outrigger. *Presented by J. Barrow, Esq., F.R.S.*

Miscellaneous.

Copper Shell for Musket, found at Bomarsund. *Presented by Lieut. J. W. Pike, R.N.*

Flag used by the Crew of H.M.S. Niger when they opposed the Mutineers at Sheerness in 1797, and presented by them to their Captain, Ed. James Foote. *Presented by Admiral Stanhope, in the name of his wife, daughter of the late Vice-Admiral Sir Ed. Jas. Foote, K.C.B.*

Medal issued for Services in India between 1799 and 1826. *Presented by the Secretary of State for India.*

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TENTS.

Invented by himself.

BY MR. GEORGE TURNER.

IN instituting the improvements which I flatter myself I have effected in tent construction, my greatest desire has been that they may lead to a considerable change in the system of encampment, and be the means of removing much of the hardships hitherto incidental to a campaign, and of improving generally the sanitary condition of the soldier in the field. Of all the causes tending to weaken the effective force of an army, disease is the most formidable, and nothing extends and strengthens its ravages more than wet nightly lodging, bad ventilation, or insufficient shelter from the inclemency of the weather.

And in respect to the wounded or the sick, it is a notable fact that there is no assistance the skill of the surgeon can receive in promoting a cure, equal to enabling his patients to breathe a pure air and affording them the comforts necessary to their condition.

Canvas constructions of the ordinary kind mostly fail when their services are required, viz. in wet, stormy, and inclement weather, and the tents and marquees used by the British Army in the Crimea may fairly be classed amongst the worst of the kind.

No event of the present day has stirred the public feeling to so great an extent as the ever to be regretted sufferings and decimation of those gallant soldiers composing the British Contingent in the late Crimean campaign—sufferings which called forth feelings of sympathy from every breast, and were characterised by Lord John Russell, in the House of Commons, as being truly heartrending and afflicting.

To those who watched the progress of that war, and read the interesting letters of the correspondents of "The Times," and other journals, and the letters from officers and others, published at the time, it must be evident that most of those disasters were traceable to the wretched shelter afforded to the troops by the old regulation "Tents," and to the inadequacy of the means provided for alleviating the sufferings of those disabled by wounds or sickness.

The following are selections from many of the statements which have appeared in the public prints on the subject.

Mr. Russell, in his correspondence, remarked that on the 14th November,

"A fearful hurricane passed over the camp; all the tents were blown down, and the "men exposed to cold, rain, and hunger for the day.

"Last night it blew cold and fierce, rain and sleet fell in torrents, and many tents were "blown down in camp; I need not say that those who were suddenly exposed to the "violence of the elements were in a very sorry plight indeed.

"A bed with a lively little sewer intersecting it, is not the most agreeable thing in "winter time.

"The beggar who wanders about the streets of London in the rain leads the life of a "prince compared with the British soldiers who are fighting out here for their country.

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"They have no shelter, no rest, and no defence against the weather; the tents let the "rain through like sieves, and are perfectly useless as protections against the weather.

"Think what a tent must be pitched as it were at the bottom of a marsh, into which "some twelve or fourteen miserable creatures, drenched to the skin, have to creep for "shelter, after twelve hours vigil in a trench like a canal, and reflect what state these "poor fellows must be in at the end of a night and a day spent in such shelter, huddled "together without any change of clothing, and lying packed up as close as they can stow "themselves in saturated blankets.

"Men have been frozen in their tents.

"The camp was visited by a hurricane to-day. The whole head-quarters camp was "beaten flat to the earth, and the unhappy occupants were rushing through the mud in "all directions, in chase of their effects and clothes.

"Our fine patent stoves are wretched affairs. They are made of thin sheet iron, which "cannot stand our fuel; besides, with charcoal they are mere poison manufactories, and "they cannot be left alight in the tent at night.

"The cold is developing itself, and I regret to say our efforts to guard against it have "been attended with mischief. Captain Swinton, of the Royal Artillery, was found dead "in his tent, suffocated by the fumes of charcoal from a stove, which he had placed within "it for the purpose of warmth.

"Lieut. Ramsbottom, of the 97th Regiment, was found dead from suffocation by char-"coal. He had come from duty in the trenches, and had closed his tent and laid down "for a few hours.

"Although the tents stood, they flapped about so much, and admitted such quantities "of snow, rain, and filth from outside, that it was quite out of the question to sleep in "them. Our general's marquees were as incapable of resisting the hurricane as the bell "tents of the common soldiers.

"We hear that the hospital tents are all down, and that the sick have had to share the "fate of the healthiest and most robust.

"There are 20 cases of frost-bite out of 125 patients brought by the Melbourne. The "greatest number of these patients affirm that the frost-bite came on while they were lying "sick of some other disease in the temporary hospital huts and marquees."

A correspondent of "The News of the World," after sundry remarks upon the weather, observed—

"It has also rained hard, completely swamping some of the tents, and the hospital of "the Grenadier Guards was inundated to such an extent that the men were obliged to be "moved out of it. The deaths are increasing frightfully. The daily average is now "seventy. Literally speaking, the men perish from cold and want of shelter."

An officer of the 2nd Royals, writing to the "Times," stated—

"January and February, with part of March, are very bad, and the cold will be most "intense. What we shall do in our tents I know not; we cannot make huts, as there is "no wood. In the cold and damp tents it will be miserable. The tents all leak, and the "men are lying 15 together in a place where no English gentleman would put his pigs."

An army surgeon, writing also to the "Times," soon after Inkerman, observed—

"Our tents were blown down lately, and deaths from exposure, rain, snow, and sleet "took place. We could light no fires, and for 48 hours were in a terrible plight."

And the Hon. Captain Maxwell, of the 50th Regiment, in a letter to his brother, Lord Farnham, made the remark—

"I shall never forget the suffering I endured for five or six days, in a miserable, cold, "wet tent, with nothing but the ground to rest upon, and two blankets to cover me."

The foregoing are but a few of the many complaints made upon the subject, and it was in consequence of reading some of the earliest of those accounts that appeared in the press, that I first committed myself to the task of remedying such glaring defects.

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Many years of the early part of my life have been spent at sea. A great portion of time passed among the natives of the Islands of the South Pacific at New Caledonia, Erromanga, Tanna, the Society and other groups, gave me many opportunities of observing the practices of savage life, and fitted me in a great measure for the task I entered upon.

A careful observation of the subject soon convinced me that the tents and marquees were wanting in the following particulars, viz.: *Stability*, a proper system of *Ventilation*, impermeability to *Wet*, means of sleeping the men off the ground out of the mud and mire, and a practical plan of fitting stoves for fires, to guard against *Frost Bite*, and yet not to affect the inmates by the *Smoke* and other *poisonous exhalations*.

Some deep thought was requisite, in order to combine so many advantages, without making a tent too cumbersome an article to be portable. A few hours' consideration however gave me the key to the whole; and how far my efforts have been successful, and in what way I have effected the improvements requisite, may be seen by the following brief particulars, and the appended reports of the *officers* who have had the *direction* of the *trials* of my *tents* at *Aldershot* and *Chatham*, as well as by the *statements* of the *Press* in *their favour*.

These improvements, I believe, comprise all that can be desired in habitations of this nature, and are classed as follows:—

1st. *Stability*, which is obtained by an improvement in the construction and arrangement of the framing and ground fastenings. The stays or framing which support the covers of the tents are of galvanised wire cord, and are adjusted to a metal collar through which the pole or support is inserted, and from which they lead to the ground. Each stay or cord is secured to an improved peg or fastening which is simple, strong, and light. I have different descriptions of pegs adapted for either soft or stony ground (figs. 1, 2); but those in use at the trials my tents have latterly undergone were made of rod iron, and consisted of one turn of a screw at the bottom of a shank. These screw-pegs can be easily repaired or replaced by an ordinary smith in case of damage or loss, if spare ones are not in reserve. They screw into the ground without disturbing the surface, but should the surface soil be too light to afford proper holding power, they can be screwed down until firm holding is obtained.

Fig. 1.—Screw Peg Fastening for Tents & Marquees.

Fig. 2.—Driving Peg Fastening for Tents and Marquees.

As they enter the soil without noise, their use for guard or outpost tents would be advantageous, as a tent could be pitched to shelter an outlying picket at night, close to an enemy's videttes, without attracting attention, an impossibility with the wooden peg, which requires driving with a mallet.

They vary from 9 to 12 inches in length, and weigh from 12 to 16 ounces, the smallest one when screwed has borne a strain of 830lbs. before drawing out of the ground, and a tent can thus be so firmly

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secured that no wind will affect it, neither would any accumulation of snow upon the roof be likely to break it in. The wire cord used for stays is about $\frac{3}{16}$ths of an inch in diameter, and, being extremely pliable, can be spliced or knotted the same as hempen cord. Although it weighs but half an ounce per foot, it requires a strain of 600lbs. to break it, and will last for several years in constant wear.

When stowed, the stays fold up with the roof without fear of derangement or injury, and but very slightly increasing its bulk as a package.

The arrangements for suspending hammocks or cots by means of struts or rods, according to my plans, add considerably to the strength and stability of the tent, as, when the hammocks or cots are down and in use, the weights all tend to a common centre, and remove the strain from the pegs or fastenings.

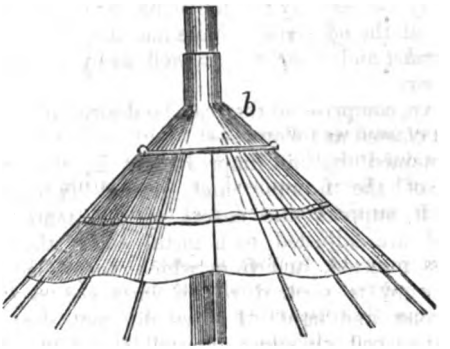

FIG. 3.—Top of Tent on enlarged scale, showing Ventilator. (*b*) Ventilator closed.

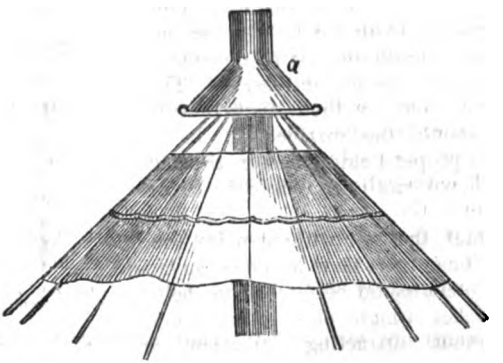

FIG. 4.—Top of Tent on enlarged scale, showing Ventilator. (*a*) Ventilator open.

2nd. *Improvement in Ventilation.*—This is effected by a very simple arrangement. An aperture is left in the top of the roof, immediately around the pole or tube. A hood or cover is fitted above it, and can be raised or lowered at pleasure by a simple pulley (see figs. 3, 4); the aperture is thus protected from the pressure of the external air, and the temperature of a tent or marquee placed under most perfect control, the simplicity preventing any fear of derangement to the apparatus. The hoods are of a description adapted to the shape of the roof; they are easily adjusted, and, when out of use, fold up and stow away with the covering. No system of ventilation can be perfect that does not protect the aperture from the pressure of the external air, and the aperture must be capable of being increased or diminished at pleasure, so as to regulate the temperature according to the climate.

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The perfect ventilation obtained in these tents will be apparent from the register of the thermometer, as taken at Fort Vincennes, Paris, in June 1857, during a trial of my tents against the best used in the French Army. A thermometer was placed on the pole of each tent, and the following is one day's register of the same, commencing at midnight on the 9th, and ending at midnight on the 10th, viz.:—

Time.	My Tents. Degrees Fahrt.	French Tents. Degrees Fahrt.
Midnight 9th	70	64½
8 A.M.	68	63
6 „	68	66
9 „	70	79½
Noon	70	79
8 P.M.	64½	71½
6 „	62½	64½
9 „	61	62½
Midnight 10th	66	61½

This statement proves that my tent was warmer at night and cooler in the day-time when the sun was out than the French tent, and could have been made cooler by day had such been required, as the ventilator was nearly closed. The French tent, on the contrary, had no means of regulating the temperature.

In hot countries, ventilation may be further assisted by raising the curtain or wall of a tent, either partially or wholly, thereby giving free admission to the air, and effectually dispersing all damp and noxious vapours. The doorway is also a great advantage in ventilating my tent. This is effected by raising the lower portion of one of the gores or sections of the roof, which not only admits the air freely, but acts as an awning to the entrance, and screens it effectually both from sun and rain. Again, by tricing the hammocks close up to the top of the tent, they touch each other, and form an air-chamber between them and the roof, which entirely excludes the heat of the sun, and renders the interior quite cool; the curtains can also be kept up at night, if necessary, without fear of draughts or other inconvenience.

3rd. *Waterproof material for the roofing of tents and marquees.*—This is composed of mineralized india-rubber double-texture fabrics. The mineralizing process destroys the tacky or sticky properties of the india rubber, and renders it perfectly impermeable to moisture, &c. Being proofed at about 300 degrees, it is unaffected by either heat or cold; any damage to this material by shot or otherwise can easily be repaired in a few minutes.

As well as sewing, the seams are secured by means of light rivets, which add greatly to their strength. Besides its waterproof qualities, the material is opaque, and one great annoyance in an Indian climate, the dazzling light occasioned by the sun's rays penetrating the ordinary duck coverings, would be removed.

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The curtains or walls are of light cotton canvas or duck, and depend directly from the roof to the ground (fig. 5), the height varying from

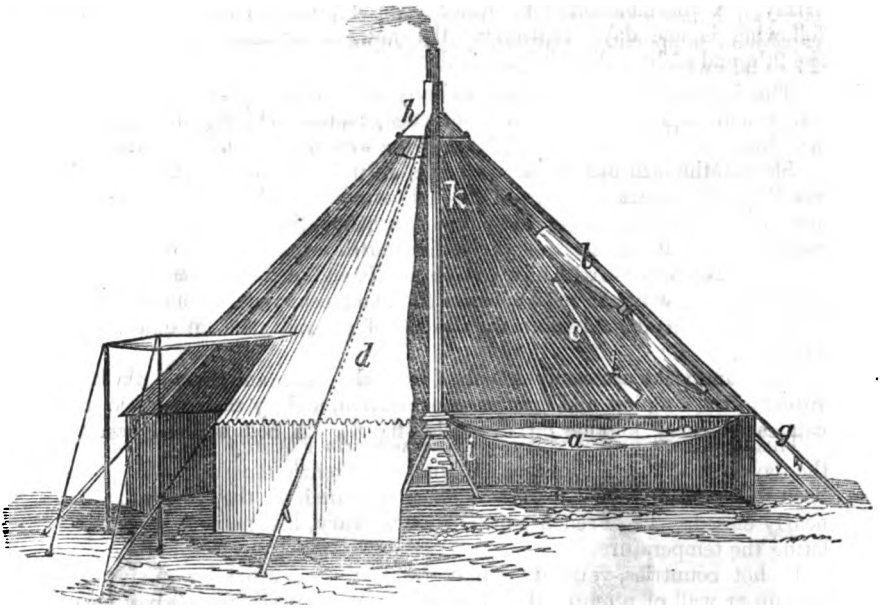

FIG. 5.—Tent, fitted with Hammocks and Fireplace. (*a*) Hammock as in use; (*b*) Hammock as stowed, when out of use; (*c*) Method of stowing Musket; (*d*) Cover of Roof; (*e*) Curtain to do.; (*f*) Door open to the full extent; (*g*) Tent Lines; (*h*) Ventilator; (*i*) Fireplace; (*k*) Tube forming Flue to do., and support to Tent.

three feet in tents to six feet in marquees, and are fitted either permanently, or laced to the roof. The height of the wall allows a man to stand upright at a greater distance from the pole in my tents than in the present ordnance tents, whilst in my marquee a man can stand upright close to the wall.

Common canvas or any other material can be used for roofing if preferred, but it has the disadvantage of not being waterproof, and of becoming much heavier for transport when wet, which causes an increase in weight of about 75 per cent.

The way in which the roofing is adjusted and secured to the framework prevents the unpleasant flapping motion so common in the old tents and marquees in boisterous weather, and draughts are also so effectually excluded that a candle will burn under them as steadily as in a room. The material of the roofing may be preserved from rot or mildew in case of being packed in a damp state.

4th. *Sleeping accommodation for troops and others off the ground without the use of bedsteads.*—This most desirable and important advantage is attained by suspending hammocks or cots by means of light wooden struts or rods, one end being attached to a loop or eye fitted to the wire rope stays, and

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the other hooking on to a flange fitted at a convenient distance from the bottom of the pole or chimney tube, whichever is used (see fig. 5).

My tents lately tested at Chatham and Aldershott were fitted with eighteen hammocks, and the framing of the tents have been proved capable of supporting continually that number of men, averaging from 24 to 26 cwt.

The hammocks are disposed radially around the pole, and when in use, are from 12 to 18 inches from the ground. During the day they are drawn close up to the roof, leaving the area of the tent quite free.

Should the hammocks on one side only be in use at one time, the stability of the tent is but little affected, as a test lately made proved that not more than an inch of deflection was perceptible in the pole. The weight, however, should be equally distributed around the pole.

A tent can be fitted with nine cots in lieu of eighteen hammocks, each cot requiring two struts or rods, whereas the hammocks requires but one.

The cots are adapted more for the use of the sick, and for officers and civilians.

The hammocks are easily detached from the tents, and form ambulance litters of the simplest and lightest construction, and by their use two men can easily carry another off the field (fig. 6). A belt is fitted over the

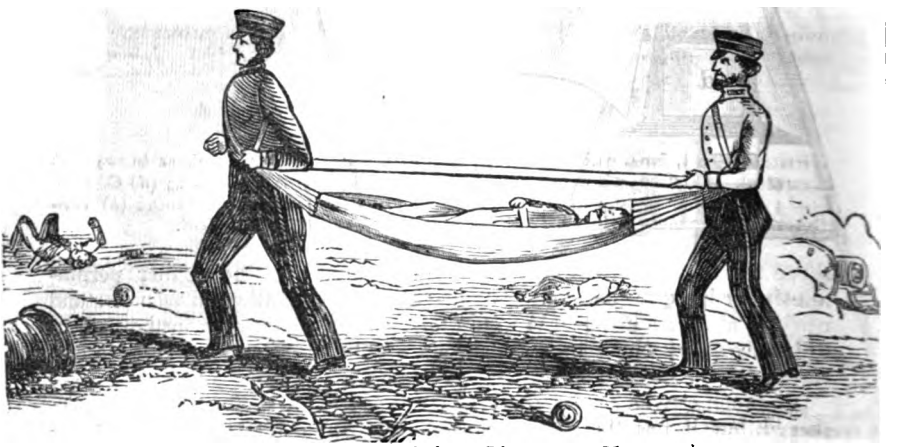

Fig. 6.—Hammocks in use as Ambulance Litters; two Men carrying one.

shoulder, having an eye into which the hook of the strut is inserted, and they are thus enabled to carry the weight with ease (fig. 7). In a hot sun, the wounded men may be sheltered from its rays by a light covering being placed over the pole, and air would be admitted freely at the ends.

Fig. 7.—Belt for carrying Ambulance Litters.

A very important feature in this method is, that the bearers are not only able to carry their rifles with them when so employed, but can use them, if surprised, without placing their burden on the ground, the arms being left entirely free.

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In case of emergency, a lower tier of men can sleep upon the ground, according to the method at present adopted, thus enabling a tent to accommodate nearly a double number of men.

5th. *Warming a tent or marquee*, without subjecting its occupants to the deleterious and often fatal influences experienced by the ordinary method of placing a stove containing charcoal or wooden embers in the tent.

I effect this by making the flue of the fireplace the support of the roof, in lieu of a wooden pole, by which means the smoke and poisonous gases are effectually carried off, but a wooden pole can be used, if desired, to save weight, as they can be shifted from one to the other in a few minutes at pleasure (figs. 8, 9).

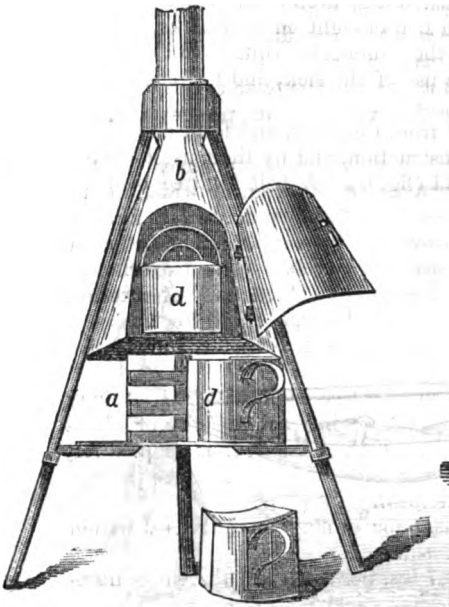

FIG. 8.—Fireplace as fitted to Tents, made to take to pieces. (*a*) Fireplace; (*b*) Hood over do., Door open; (*c*) Stand for Fireplace and Saucepans, and Stay for Legs; (*d*) Saucepans.

FIG. 9.—Another method of fitting Stoves to Tents, &c.; Tube supported on Tripod; Stove connected with Elbow Joint.

The fireplace is of a light and simple construction, and will burn any kind of fuel, even grass or roots. It throws its heat equally to all parts of the tent or marquee, and is adapted for cooking as well as heating purposes.

In a trial recently made with a fire of wood only, the temperature of a tent was increased 25 degrees in 30 minutes from the time of lighting.

When packed for use the stove and chimney tube occupy less space than a wooden pole, each tube being arranged so that one part stows into the other, making a compact parcel of about a third its entire length; the stove, as well as the hood for conducting the smoke into the chimney, fold together into a very compact and small parcel.

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The fire can be used at night without endangering the tent or hammocks, thereby keeping the interior perfectly warm and dry in the coldest and dampest weather.

Any description of stove can be fitted to the chimney tubes, and more than one stove to a marquee if necessary.

6th. *Durability.*—My method of fitting wire-rope stays to support the roofing of tents and marquees affords a framework for the covers to rest upon. The coverings spread evenly and smoothly thereon, and all stress from the pressure of the wind is completely removed, the strain being borne by the stays. This adds greatly to the durability of the material, as the principal cause of tent covers tearing so frequently results from the canvas forming the only support to the poles, in which case it has to bear the whole strain and pressure of the wind. The wire stays or framing can be fitted to other covers when the first are worn out, as the wire cord is calculated to last for many years.

Though more expensive in the first cost, my tents and marquees will be found more economical in the end than those in present use, on account of their great durability.

7th. *Stowing fire-arms.*—Each tent is fitted with appliances for the stowage of the fire-arms and accoutrements of the men, by which means they are kept dry and ready to hand, in case of sudden alarm (see fig. 5).

Comparison of weight and stowage between the present pattern of Ordnance tents and marquees and those of my own construction.—The Government tent weighs 65½ lbs. when dry, and has a cubical capacity of interior, when pitched, equal to 512 cubic feet, or at the rate of 5½ lbs. and 42½ cubic feet per man. This tent is about 13 feet diameter, and 10 feet 6 inches high.

My own tent of 16 feet diameter and 10 feet high, with a stout duck roof, weighs about 100 lbs., and contains an internal capacity of about 900 cubic feet, being for 18 men, the number the tent is adapted for, about the same weight and capacity per man as the Ordnance pattern. The bulk, when packed, being also identical.

If fitted with the waterproof material for roofing, an increased weight of about ¼ lb. per man would be the result.

The hammocks and fittings weigh 7 lbs. per man, and the whole number for one tent occupies 6 cubic feet when packed.

If fitted with stoves, the extra weight will be 8 lbs. per man.

The hospital marquee used by the army at the present time is 29 feet long and 14½ feet wide. Its weight, when dry, varies from 428 to 507 lbs., and contains about 8,300 cubic feet of air.

A marquee of my construction, of the same size and internal capacity, fitted with a waterproof roof and lined throughout, would weigh but 340 lbs. fitted complete with all my improvements except stoves, each of which would add about 80 lbs. to the weight.

The bulk of the Government marquee packed is 26 cubic feet, against mine of 16 feet, the difference being on an average about 120 lbs. in weight, without stoves, and 10 cubic feet in bulk, and the larger the construction the greater will be the saving of weight in my marquees.

The following extract from the Report of Sir John McNeill and Colonel Tulloch will prove that marquees are highly essential for field hospitals:—

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"The circular tent used in the British Army, which is calculated to contain 15 men, is altogether unsuited for an hospital in any climate. It affords very insufficient protection against cold, or rain, or heat. When there is much wind in wet weather, the rain beats through the canvas; and when it blows upon the door, which is continually opened for ingress and egress, the rain is driven to all parts of the tent. The pole being in two pieces for convenience of carriage, is weak at the joint, and in stormy weather is apt to give way. The side wall is too low to admit of the use of any kind of cot, if there be more than two or three men in the tent; the space is too confined to admit of proper attendance on the patients, even by the medical officer; and it is impossible, with safety, to use a stove or other means of warming it. In short, whatever may be the supposed advantages that have led to its adoption as a barrack tent, it would be difficult to contrive anything much more unfit for the accommodation of the sick."

As a general field hospital, I beg to offer a novel and peculiar adaptation of my system, by means of which six to eight marquees may be made to branch off from a common centre, in the form of a star, thus embracing a number of wards, in connexion with, yet distinct from, each other, while the part at the centre forms a place for the meeting of the medical men, the duties of the apothecary, and for surgical operations, out of view of the patients. At the same time, the whole of the wings of the wards will be under the eye of the attendants. A construction of this nature, with six wings, each 60 feet long by 16 feet wide, would afford accommodation for beds, and possess ample means for warmth and ventilation, and effect a great saving in weight over the same number of marquees containing equal accommodation, if fitted separately.

My hospital bedsteads fold up into a compass 2 feet 3 inches by 8 feet and 2 inches deep, and are fitted with a shelf at the headpiece, which will be found an important adjunct, as the patient can have his medicines or food close at hand, and thus help himself in the absence of an orderly or nurse. They are very strong and yet of light weight.

For the want of tables for surgical operations in the Crimea, many a poor fellow suffered severely during amputation. The tables which I have designed for my hospital marquees, although specifically designed for surgical purposes, are equally adapted for other uses. They are light, without sacrifice of strength, and, being fitted to connect in their several parts, are immediately available for use.

The oven designed by me for camp use (forming also a case for storing saucepans, &c.), answers equally as a boiler or stewpan, and must be used outside the tent, and separately from the stove. It is composed of two cylinders, one within the other, leaving an air chamber or space between them: in use it has proved to be most efficient, and will roast coffee, bake bread or any kind of food, in the shortest possible time, without fear of burning, as the inner cylinder is heated by the hot air in the chamber, and has a ventilator affixed at the top to regulate the heat. The manner of using it is a modification of the method of cooking practised by the natives of the South Sea Islands: a shallow hole being dug in the ground, and the bottom paved with stones or bricks, roughly laid, a fire is to be made upon them of any brushwood or rubbish that that can be obtained,

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and when it has subsided to an ember, the oven is to be placed over it, and its sides banked up with earth to keep in the heat, a small hole being left on either side for vent. In ten to fifteen minutes the oven will be fit for use. A piece of beef, 16 lbs. weight, has been baked by this means in two hours, and potatoes in twenty to twenty-five minutes. This does away with the constant boiling so loudly complained of, and enables the soldier to vary his meals by an occasional baked joint, hash, or stew. At Chatham, a leg of mutton of 12 lbs. weight was cooked for the serjeant's mess of 3rd Depôt Battalion in one hour and ten minutes.

The theory of encampments involves no question second in importance to that of sheltering the troops. Sent forth to fight our battles, they have surely a right to expect that, on the score of humanity alone, the greatest ingenuity will be exerted to devise means of preserving them in health and strength; but, independently of the promptings of humanity, the necessity of economizing the resources and preserving untarnished the military reputation of the nation must be held by every patriotic and enlightened mind as constituting the strongest motive for preserving those who are willing to devote their lives to their country's defence.

Man's nature and constitution will not permit him long to endure exposure with impunity; and it is a mistaken notion to imagine that soldiers can fight battles and bivouac any length of time without proper shelter from the weather. All soldiers suffer sufficiently during a campaign from other and irremediable causes, but to oblige them to seek repose frequently in wet clothing and lying on wet ground in inclement weather is certainly fatal to health and life; and the military history of Europe affords numerous examples of the folly of the practice.

Mr. Russell, when writing on the subject, has observed that "the "cheapest, wisest, and most humane plan, unquestionably, is to spend money "on the soldier; to supply him abundantly, keep him warm, and feed him "well, of course without pampering him, or accustoming him to luxuries.

"The British soldier is too valuable an article, and too difficult to "replace, to be allowed to perish for want of due provision for his health "and comfort. What would we not give to get back those battalions of "well-trained veterans who perished in the mud and misery of last winter! "Such soldiers are not to be replaced for years; and recruits, however "strong of heart and arm, cannot fill the void left by men who have been "long under the colours."

"The Times" in its columns, under date of the 19th June, 1856, when writing upon the war in the Crimea, made the statement, that "20,000 men died of disease, cold, hunger, and nakedness, and such ordinary causes, whilst less than a fifth of that number were killed by the enemy," and further remarks, that "the duties of self-preservation are of primary importance in war, not falling below the art of killing the enemy. Indeed it appears, if we improve so far as to be able simply to keep ourselves in the presence of the foe, while he does not improve in that respect, we must conquer him by mere vitality—by a proper use of meat, drink, clothing, and housing; for while he is perishing by thousands, we shall simply survive him."

It is impossible to calculate the loss a country sustains through sickness in the ranks of its army. Many a battle may be lost, or a victory

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but half achieved, may be the consequence; but, independent of this, and putting considerations of humanity also aside, the result is costly to a country like England, where no conscription enforces the enrolment of men, but all are obtained through the medium of the recruiting serjeant and the bait of a bounty.

Directly a soldier dies, or becomes incapacitated for service through sickness, his money value ceases, and his place must be filled up by another. The money is lost to the country, and the effective strength of the army weakened, until the gap is filled up.

A correspondent of "The Times" has remarked upon the false economy of retaining so frail a covering for our troops as the old regulation tent.

"Canvas *versus* Life.—We cover numberless vans and Railway waggons "at home with durable tarpaulin; we cover our soldiers abroad with tents "made of porous canvas, such as Pickford would scorn to use.

"If our valuable goods can be thus protected, why cannot our invaluable "soldiers be equally well screened?

"Nothing is more destructive to the health than wet nightly lodging; "and the false economy which abstains from furnishing the waterproof ma- "terial, contrasts badly with that remarkable instance of true economy, in "a matter where canvas and men's lives were concerned, recorded of Lord "Nelson (by Alison, chap. xxxix. p. 356), who, on bearing down on the "enemy at Trafalgar, made signal when the ships entered into action to "cut away their canvas, in order that no hands might be lost in furling "sails. The loss to the fleet in a few minutes was £200,000, but to this "admirable piece of foresight much of the early success was owing."

The legislature of this country are fast becoming aware of the necessity of providing for the health of the soldier.

Lord Ebrington, in May 1855, drew the attention of the House of Commons to the subject of barrack accommodation, and pointed out the defects of the system in a series of resolutions.

He was warmly supported in his remarks by several Members: Lord Palmerston, Sir Harry Smith, and the Right Honorable Mr. Sydney Herbert, the present Minister of War. Amongst the number, Lord Palmerston observed that, "money spent in improving barrack accommodation was a most economical expenditure, because it not only was a direct saving of money through the health of the men, but it also promoted the efficiency of the service."

The present Minister of War added, "that the question was truly one of expense, but they could not do worse than kill good and well trained men on that account."

Surely the same arguments are equally applicable to tents, because men are more under canvas in time of war, a period when the health and life of the soldier are of the most value; and, since it has become the practice to place our troops under canvas in the country, during the finer portions of the summer months, in order to inure them to the practices of a camp life, it must be also desirable that their health should be preserved whilst learning these necessary duties.

The state of affairs in India justifies the belief that a large European force must necessarily be required for some years to come. These troops must be housed and efficiently protected from the climate, which is such

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as occasionally to demand their removal to healthier localities in the mountain districts, where encampments in the open air will be infinitely preferable to the prescribed limits and close confinement of towns. China, too, whose climate is peculiarly inimical to European constitutions, is just now dividing our attention, and many troops will be required for service in that country. The French Government have issued a code of regulations for the guidance of their troops in China; among other things they strongly recommend their avoiding (by any means in their power) sleeping on the ground at night, though it is difficult to imagine how this is to be accomplished with the means at their disposal. I trust however that the tents of our own soldiers may be so improved that the details of disaster and death which so distressed us in the Crimea may not be revived in that remote region.

That all the Government tents are as defective as those in use in the Crimea, and consequently as unfitted for the use of our troops, both in India and at home, will be evident by the following statements from the press:

"The camp at Dover no longer exists. Its occupants, who had hitherto been so quiet, were suddenly in disorder and confusion, from finding their drenched tents blown down by the unexpected gale, which continued to rage for some hours. The soldiers, after fruitless endeavours to keep their tents, were under the necessity of abandoning them, and, finding themselves without shelter, unanimously agreed to leave the camp and enter the town."—ILLUSTRATED TIMES, *October 25th*, 1856.

"During the gale of Thursday week, the whole of the tents of the encampment belonging to the Pembroke garrison at Freshwater East were blown down."—LLOYD'S WEEKLY LONDON PAPER, *October 17th*, 1858.

An officer, writing from the seat of revolt in the East, says—

"I arrived here (Loodianah) last night, after a tiresome march. Those who know India can tell how hot a tent is in May. My tent was blown down on the top of me, and my friend who accompanied me. We were very nearly 'squashed' by it, and had to sit out all night on the ruins, in dust, rain, and wind."—*Vide* TIMES, *September 1st*, 1857.

An officer of the 61st Regiment, who had charge of the party that took the palace at Delhi, and afterwards had the custody of the old King, dating from Ajmere Gate, Delhi, September 28th, 1857, writes as follows:

"The wing to which I belong left Ferozepore on the 25th July, and arrived here on the 14th August. You may fancy how hot it was in tents: the wonder was we did not all die from it."—*Vide* TIMES, *27th November*, 1857.

Admitting the important position the consideration of weight and bulk in baggage must always occupy in connexion with the subject of active movements in the field, I would humbly submit that the first care should be the maintenance of an army in as full force and efficiency as possible.

Every soldier placed *hors de combat*, either by wounds or sickness, not only weakens the effective force, but operates as an impediment upon the movements of an army, to a far greater extent than a small increase in the weight of baggage. He must be attended to, cared for, and moved (if on the march), with all the care possible under the circumstances. Baggage can mostly be destroyed by a retreating army, to prevent its

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falling into the hands of the enemy; but the sick cannot be so disposed of, and no greater disgrace or reverse can befall an army than that of deserting their sick to the foe.

Of late years, it has become the practice in most European armies to increase the weight of field ordnance. This entails extra transport for ammunition, and more horses for the movement of the guns. The object in view is to gain an advantage over the opposing forces. How much greater the advantage, if the troops can be kept in health and available for all contingencies?

The trifling addition to the baggage by using the patent tent in its most perfect state would be as nothing compared with the addition to the ordnance; while the patent tent, embracing several important advantages, can be used under its lightest form at a weight not exceeding the one at present in use; and in respect to marquees for hospitals or cavalry stables, the advantage of weight is entirely on the side of the improved system of construction.

Viewing my tents in connexion with the billeting system, Mr. Charles Cowan made a motion in the House of Commons, animadverting upon the demoralizing system of billeting troops in Scotland, and proposing to supersede it by the erection of supplementary surburban barracks throughout the country. Were the armies supplied with the tents of my construction, the billeting system might be far more effectually, and less expensively, superseded than by the plan proposed. The tents could be kept in store under the care of the quarter-master, while the men were in barracks, and when on the line of march they could easily convey their tents by light baggage cars, and pitch them for use in any given locality. The duties of the men, thus constantly alternating between camp and barrack life, they would become thoroughly familiarized with their tents, and pitch and strike them with the greatest ease and expedition.

This system would also be found invaluable in the event of an epidemic breaking out among troops in barracks, as they could easily be removed to any open and healthy locality in the neighbourhood out of the reach of the contagion. It may be argued, that the common tent would also answer that purpose; but it must be borne in mind, that placing men on the ground under an ill-ventilated and crowded tent would be likely, at such a time, to aggravate rather than mitigate the evil.

In the month of February, 1855, I first commenced the construction of my improved tent; from that time to the present I have been unremitting in my endeavours to get them adopted by Her Majesty's Government. In May, 1855, I placed my models before a Committee sitting on tents at Woolwich, and in August of the same year erected a full-sized tent at the Wellington Barracks in St. James's Park.

About this time a great number of invalids had returned from the Crimea, and many of them were located at these barracks. The whole of these men affirmed that my tent would have been instrumental in preventing the losses the army had sustained, and many of them added that if they were sufficiently recovered they would gladly volunteer to return again if they could make certain of having such comforts as my tents provided.

A few weeks ago, being at Chatham, Captain Durnford, of the Royal

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Engineers, brought to me a sergeant of that corps in order that I might hear his opinion upon my system of fitting hammocks to tents.

The serjeant observed that the plan would have been invaluable in the Crimea, and would have saved thousands of lives; Captain Durnford added that the serjeant was in the Crimea from the landing at the Old Fort until the final evacuation, and had seen numbers carried to the hospitals merely from sleeping on the ground.

As will be seen by the previous statements, my tents were before Her Majesty's Government long before huts were thought of as a shelter for our troops in the Crimea. That those huts utterly failed in their object is a matter of history; and that they were immoveable when once put together may be gathered from the fact that the army were obliged to leave them behind on leaving the place, and it now appears that the inhabitants of Sebastopol are rebuilding their town with them. The whole of the cost of these huts was lost to the nation, whereas had my tents been used they could have been struck and packed in a few minutes, and ready for use at another time.

I have heard of numerous inventions in relation to military appliances, which seem to have for their chief object the destruction of life in the shortest possible time; but in my remarks this evening, I have endeavoured to show what may be done to preserve the life of a soldier, especially when engaged in active service in an enemy's country.

A MEMBER inquired whether any sewing was required at the seams in addition to the rivets, or was it a mere solution that held the seams together. He also inquired the amount of contraction or expansion per square foot, upon the exposure of the material to the rain, or the sun's heat.

Mr. TURNER: There would be no more expansion than in ordinary linen fabric or duck, as the India rubber was contained between the two fabrics.

In answer to a question from the same Member as to the amount of wet that would be absorbed—

Mr. TURNER said, that it would be very trifling indeed, on account of the rain not penetrating the entire surface. The utmost increase in weight would be about ten or fifteen per cent., whereas the common duck, under the same circumstances, would be increased in weight about seventy per cent. on the whole.

Captain BURGESS inquired what means there were of preventing the canvas from catching fire from the stove.

Mr. TURNER replied, that it in no way came in contact with the stove or funnel. Upon this subject he could not do better than refer to the Report of Quarter Master Menzies, of the Chatham garrison. He said:—

"With a view to testing whether any damage might possibly arise from the ignition of the tent, a large fire was heaped upon the stove, and, as an experiment, a rope was tied round the funnel; this severe trial lasted for some hours, and, upon inspection, it was not found that any injurious effects had resulted, and upon the removal of the rope it was not charred or burnt, although the heat carrried off by the pipe during the time had been intense."

Capt. BURGESS: Is it not the case that stove chimneys of the ordinary construction frequently get very nearly red hot?

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Mr. TURNER: Yes, but there is no contact here. It is simply the hot air passing up the funnel. The fireplace does not touch the iron hood, and the smoke passing through the funnel merely gets it to steam heat.

Capt. BURGESS: Is the cap over the chimney made of wood or iron?

Mr. TURNER: Galvanized sheet iron, about three inches deep. The wire ropes are all attached to the flange at the top of the pole or chimney.

A MEMBER: Are the wires attached to the tube before raising?

Mr. TURNER: Yes; the method of raising is very simple. A circle is staked out by means of a line, and pegs are screwed in at stated intervals. The centre being marked by means of a wooden plug, the funnel or pole is passed through the flange, fixed into the centre in its proper place, and the lines depend from it, and are hooked on to the pegs. In striking tents, the lines will unhook at once, and the hooks are slightly curved to prevent any flapping motion detaching them from the pegs.

The CHAIRMAN: Will you favour us with a few remarks as to the comparative cost of your tents?

Mr. TURNER: The Government marquee, the dimensions of which were 29 by 14 feet, and 5 feet 8 inches high at the walls, cost about £34, and contained at the outside about fourteen men, whilst my own of the same size and dimensions, for the same number of men, would cost, if fitted with duck, £33, and, if fitted with waterproof material, about £42. The Government tent of the common size for twelve men costs about £3 10*s*. Mine, for eighteen men, fitted with duck wall and roof, would cost 15 guineas, or with waterproof material £20. The latter tent, however, would last three times as long as the former, besides the extra advantages of stability and comfort. The above cost includes my new screw pegs, but not the stove, which costs from £4 to £5, according to the construction, and with cooking utensils another pound or 25*s*. Each hammock with a pole would cost about 12*s*. 6*d*.

APPENDIX.

Extracts from Official Reports of Commanding and other Officers at Chatham Garrison, relative to Turner's Patent Tent, Marquee, &c., from the Office of the Quartermaster-General, Sir Richard Airey, K.C.B., Horse Guards, London, obtained January, 1860.

From MAJOR-GENERAL H. EYRE, *Commandant, Chatham Garrison.*

Chatham, November 28th, 1859.

SIR,—The tent and marquee of Mr. Turner, referred to in your letter of Sept. 30, having been made trial of by the several battalions (Royal Engineers, 1st Depôt Battalion, 2nd Depôt Battalion, 3rd Depôt Battalion), I have now the honour to submit to you the result (of the trial), as shown in the accompanying reports. You will see that these reports all speak very favourably of them; and I think there is no doubt that a great deal may be said in their praise.

For a camp likely to be of any duration, in fact, on such a service as our *army encountered in the Crimea*, this tent and marquee would be very valuable, but the important

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question to have decided is, whether they can be made available with advantage on daily active service? . . . . . I am inclined to think they would bear the test, and would be found to answer better than any yet invented. . . . . .

I have the honour to be, Sir,
Your obedient humble servant,
H. Eyre, Major-General.

To Sir Richard Airey, K.C.B.,
Quartermaster-General Horse Guards.

Extracts from Reports to which Major-General H. Eyre alludes in his letter.

From Quartermaster William Mackay, *Second Depôt Battalion, Chatham.*

Chatham Garrison, 22nd Sept. 1859.

(Memorandum).

Mr. Turner's field tent, pitched by six men in nine minutes, including the fixing of the fire-place and ventilator. Struck and put into the valise, by the same number of men, in four minutes.

Advantages over the Government Field Tent.

1st. Ventilation can be regulated according to the temperature.

2nd. There being no strain on the canvas (it being merely a covering laid over a frame of galvanized wire ropes), which cannot shrink by moisture, a considerable saving will be afforded in wear and tear of canvas, lines, and tent-poles.

3rd. The pegs being screwed into the ground, no reasonable amount of pressure to which they can be exposed can draw them.

4th. It can be used either with or without a fire-place; and, as all the gear which comes in contact with the flue is iron and brass, no danger need be apprehended from ignition.

5th. The greatest of all advantages is, that the men can sleep off the ground; at first it was tried with twelve hammocks, occupied by twelve men, where they slept very comfortable; it was then completed to eighteen, the number which it is designed to accommodate; and around a wooden pole . . . . .

6th. As the ground-screws cannot be drawn; and, should they be so, the weight of the men gravitating towards the centre, prevents it being blown down by the storm, which the present Government tent is very subject to.

On the 29th September, 1859, the tent was struck by six men in four minutes, and pitched in nine minutes. . . . . .

(Signed) William Mackay.

To Major of Brigade,
&c. &c. &c.
Brigade Office.

Proceedings of a Board ordered to assemble by order of Colonel R. N. Phillips, commanding the 2nd Depôt Battalion, to report upon a Marquee and Bell Tent, the Inventions of Mr. George Turner.

Chatham, Oct. 1st, 1859.

Major F. G. T. Deshon, 2nd Depôt Battalion. *President.*
Captain William M. Lees, 23rd Regiment.
Lieutenant T. D. Wood, 29th ditto
Quartermaster William Mackay, 2nd Depôt Battalion. } *Members.*

The Board having examined the tents, viz., a marquee and bell-tent, which have been pitched for trial in the Spur Battery, report as follows:—"The bell-tent has been pitched and struck three times by six men; each time it was pitched in nine minutes; the fixing of the fire-place and ventilator being included in the operation. It was struck and packed in the valise in four minutes. The same number of men pitched and

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struck the common bell-tent in the same time; but it must be observed, that Mr. Turner's tent would have been pitched in a much shorter time, had it not been for the fixing of the fire-place and ventilator—contrivances which the men had not seen before, and which in themselves require more time in being put together than the mere raising of the pole of the common bell-tent.

The advantage of Mr. Turner's tent over the common bell-tent consists in the contrivances for the slinging of hammocks, by which the men are enabled to sleep off the ground, and in its being well ventilated by the opening in the top round the pole.

The capability of the tent being warmed by a stove, is another advantage; but, even without the fire-place, this tent is stated by the men to be more warm and comfortable than the old tent, for the fact of their not sleeping on the ground, the coldness, hardness, and dampness of which they complain. The Board have, therefore, to report most favourably on Mr. Turner's bell-tent, the construction of which contains many advantages; and they consider that it presents nothing impracticable for service in the field.

With regard to the marquee, the Board consider it possesses many advantages over the one at present in use, as to weight, and space, and means of warming it . . . . . .

(Signed)

F. G. T. Deshon, Major, 2nd Depôt Battalion. *President.*
W. Lees, Lieutenant, 23rd Regiment.
T. D. Woob, Lieutenant, 29th ditto.
Wm. Mackay, Quartermaster, 2nd Depôt Battalion. } *Members.*

To Col. R. N. Phillips,
Commanding 2nd Depôt Battalion,
Chatham.

From Colonel R. N. Phillips, *Commanding 2nd Depôt Battalion, Chatham Garrison.*

Chatham, 3rd October, 1859.

Sir,—I have the honour to forward the proceedings of a Board of Officers assembled to report upon Mr. Turner's marquee and tent, occupied by the 23rd Regiment; and, having examined these tents, I coincide with the opinions expressed by the Board . . .

I have the honour to be, sir,
Your obedient servant,
R. N. Phillips.

The Major of Brigade,
&c. &c. &c.
Brigade Office.

Extracts from the Proceedings of a Committee assembled at Brompton Barracks, Chatham, by order of Lieut.-Colonel Ross, Commanding, to report upon Mr. Turner's Tent and Marquee.

Captain Durnford, R.E. *President.*
Lieutenant Clayton, R.E. } *Members.*
Lieutenant Wynne, R.E. }

Turner's Bell Tent.

On examining this tent, for a description of which *vide* Mr. Turner's pamphlet, pages 6 to 16, the Committee observe:—

1st. That a very great advantage is gained by raising the men off the ground by means of hammocks for sleeping purposes, which may also be used for the transport of wounded men, being borne by two or four men, according to the distance to be traversed. . . .

2nd. The tent lines attached to a collar fitting on the tent pole, entirely under the covering of the canvas, seems a good point in this tent, quite obviating the serious defect of the line tearing through the canvas as in the common tent, to the canvas of which the hempen lines are attached. Turner's lines being of galvanized iron wire, do not expand and contract when dry or wet, thereby doing away with the inconvenience of slacking off

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tent lines in wet weather. It is also considered that wire rope, from its strength and durability, is well adapted for tent lines and guys. Mr. Turner serves with list those portions of the lines in contact with the covering of the tent, which appears a good precaution, preventing the contact of the wire and canvas. Attached to the tent lines are small lashings used by day for the purpose of trieing up the hammocks, and by night for securing the rifles, so that each man has his weapon at hand in case of alarm. The belts can be attached to the end of the hammock poles, nearest the wall of the tent.

Some experiments were made by the Committee to ascertain the respective holding powers of the common wooden pickets, as used in the service, and Turner's iron pegs, with the following results:—

1st. In loamy soil, the common small wooden picket drew with a weight of about 280 to 290 lbs., Turner's small screw peg with a weight of about 330 lbs. A large wooden picket for guys broke in driving, and a second of sound oak broke with a weight of about 580 lbs. Turner's medium screw was unaffected by a weight of about 920 lbs., which was the most the apparatus used would safely bear, and, consequently, the large screw was not tried.

2nd. In made ground, consisting of lumps of chalk, rough stones, and pieces of brick, the small wooden picket drew with 300 lbs. The large wooden picket of ash broke with about 800 lbs. Turner's barbed rock picket drew with about 600 lbs., and his small screw peg, which was screwed down with some difficulty, with about 800 lbs. In each case, Turner's pegs were driven in perpendicularly to the ground, and the wooden pickets slanting, as in using them for the lines of a tent. The strain was applied in each case as if by a tent line or guy.

From these experiments, it would appear that Turner's pegs answer admirably.

The Committee would express their cordial approval of Mr. Turner's system of providing hammocks for sleeping purposes. . . . . And also of his staying the tent pole with lines, and throwing a covering over all, thus ensuring perfect stability so long as the tent pegs hold; and Mr. Turner's appears to answer the purpose very effectually. They also approve of the good system of ventilation, so defective in the service tent; also of the reduced height of the tent (9 feet), and increased depth of wall (2ft. 6in.) . . .

Turner's Hospital Marquee.

Mr. Turner's Hospital Marquee, of the same size as the service one, is erected upon the same principle as the Bell Tent, having the poles or tubes stayed by wire lines, and a covering of mineralized waterproof fabric thrown over all.—Mr. Turner's Pamphlet, pages 16 to 22. . . . . The Committee would, however, remark that Mr. Turner's marquee appears to fulfil several requisite conditions for hospital purposes, being dry, warm, well ventilated, and of perfect stability. . . . . In conclusion, the Committee must observe that the advantages . . . of Mr. Turner's tents must be considered in a *hygienic point of view*, and it becomes a question for deep consideration whether the *undoubted advantages* to be derived from a tent which secures the army, in a great degree, from the bad effects of exposure to wet and cold, heat and impure air, will not, in most cases, more than counterbalance the . . . increased weight to be transported, by preserving the men in a state of health and efficiency.

(Signed)
A. DURNFORD, Captain Royal Engineers, *President.*
V. G. CLAYTON, Lieutenant ditto
E. T. WYNNE, ditto ditto } *Members.*

Brompton Barracks, Chatham, 15th November, 1859.

. . . . . .

I concur in this report.
(Signed) H. SANDHAM,
Colonel Commanding, Royal Engineers, Chatham Garrison.

The Quartermaster-General,
Horse Guards.

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Evening Meeting.

Monday, February 20th, 1860.

Captain E. G. FISHBOURNE, R.N., C.B., in the Chair.

The Chairman announced that fourteen Members had joined the Institution since the 31st of January.

LIFE MEMBERS.

Heaton, Jno. R. Major 37th Regt.

ANNUAL SUBSCRIBERS.

Reid, Geo., Capt. Beng. Cav.
Portman, Hon. W. H. B., Col. West Som. Yeo. Cav., M.P.
Leahy, Edmund, Lieut. North Cork Rifles.
Prendergast, C. L., Ens. H. M. Indian Army.
Arbuckle, G. B. V., Capt. late 57th Regt.
Slade, Alex. F. A., Capt. 57th Regt.
Goff, R., Lieut. 50th Regt.
Smyth, Jno. M., Capt. 10th Regt.
Bowden, H. G., Capt. S. F. Gds.
Mountain, R. F., Capt. Roy. Art.
Havelock, Sir Henry, Bart., Lt.-Col. 18th Royal Irish.
Higgins, W. F., Esq., late War Dept.
Blockley, John, Lieut. H. A. Coy.

PRESENTS.

LIBRARY.

Books.

Royal Artillery Institution.—Occasional Papers. Vol. I. No. 19.
Presented by the Institution.

Leeds Philosophical and Literary Society.—Annual Report of the Society, 1858-59.
By the Society.

The Invasion of England rendered impossible. Pam. London, 1860.
Presented anonymously.

Orders in Council as to Naval Rank Pay, Promotion, Retirement. 1 vol. 8vo.
Presented by the Lords Commissioners of the Admiralty.

Two Years in Ava, from May 1824 to May 1826. By an Officer of the Staff of the Quartermaster-General's Department. 1 vol. 8vo. 1827.

Penal Code prepared by the India Law Commissioners. 1 vol. 8vo. London, 1838.

Memoirs of Zehir-Ed-Din-Muhammed-Baber, Emperor of Hindustan.—Written by himself and translated by the late John Leyden, Esq. M.D. 1 vol. 4to. London, 1826.

De Stuers, F.V.A. Major. Mémoires sur la Guerre de l'isle de Java de 1825 à 1830. 1 vol. Small 4to. Leyde, 1833.

Guicciardini, Francesco. Della Istoria d'Italia. 2 vols. Folio. Venice, 1738.
Presented by John Crawford, Esq. F.R.S. &c.

MUSEUM.

Military.

2 Burmese Spears, taken at the capture of Bassein.
Presented by Dr. McCosh, H. M. Bengal Army.

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Naval.

Model of the Raft "Nancy," constructed and used at the capture of Taganrog. By Captain Cowper P. Coles, R.N.

2 Models of Rafts for shipping Horses.

Model of Mortar Raft. *Presented by Captain Cowper P. Coles, R.N.*

Model of the first Life Boat. *Presented by the Hon. J. T. Carnegie.*

Miscellaneous.

Clock Watch, time of James II. *Lt.-Col. J. Percy Neville.*

One of the Iron Plates for holding together grape shot, found in the open space in front of the Redan, Sevastopol.

Presented by T. Longmore, Esq. Dep-Inspector-General of Hospitals.

3 Medals in Bronze: viz., of Miss Nightingale, Victor Emanuel, and Lord Raglan, in case.

3 Ditto ditto, commemorative of the battles of the Alma, Inkerman, and Balaklava, in case.

1 Ditto ditto, commemorative of the fall of Sevastopol, in case.

Presented by Mr. T. R. Pinches.

Cast of the Statue of "Mars in Repose," the original in the Ludovisi Villa Museum at Rome. *Presented by E. Jekyll, Esq. late Gr. Guards.*

ON IMPROVEMENTS IN DIVING DRESSES AND OTHER APPARATUS FOR WORKING UNDER WATER.

By John William Heinke, Assoc. Inst. C.E.

Although the invention of the diving bell has been generally assigned to the sixteenth century, yet there are evidences of others, although rude modes, having been adopted long anterior to that era. Beckmann, in 1770, quoted a passage from Aristotle (problem xxxii.) to show that the divers of his time used a sort of kettle to enable them to remain longer under water; but the inference drawn does not seem very clear. The renowned friar Roger Bacon, who flourished about 1250, has been considered by some to be the originator of the diving bell, or of some machine to facilitate working under water; but little credit can be attached to the tradition. The earliest mention of anything of the kind that can be depended upon is by John Taisner, who says he saw the experiment made by two Greeks at Toledo, in Spain, in 1538, before the Emperor Charles V., and ten thousand spectators. Gaspar Schott (Nürnberg, 1664) repeats the story, and calls the vessel an "aquatic kettle;" but prefers another apparatus which he designates "aquatic armour," that enabled those covered with it to walk under water. The plate accompanying the description represents a man walking in the water, with something like a small diving bell over his head.

In an edition of Vegetius, on "The Art of War," published in 1511, there is an engraving which represents a diver with a cap on his head, from which rises a long leather pipe, with an open end floating on the surface of the water.

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Lorini, in his work on Fortification, published at Venice in 1609, gives a plate and a description of a diving apparatus, or chest, which he describes as "a square box bound with iron, furnished with windows, and has a stool affixed to it for the diver;" but he does not lay claim to the discovery, and seems to consider it as a machine already known.

Francis Kessler, of Oppenheim, in 1617, gave a description of a suit of water armour, which, however, Beckmann and others declared could not be used with safety.

About 1620, Cornelius Debrell contrived a submarine vessel, or boat, to be rowed and used under water. This was tried upon the Thames, by order of James I., and is said to have succeeded admirably; it carried 12 rowers, besides passengers. This vessel is mentioned by Robert Boyle, in his "New Experiments Physico-Mechanical," wherein he professes to give Debrell's secret from authority; he says, "the composition was a liquid that would speedily restore to the troubled air such a proportion of vital parts as would make it again, for a good while, fit for respiration." This novelty induced his Most Serene Highness Charles Landgrave of Hesse Cassel to have a diving vessel constructed for the same purpose; some years afterwards it was described (with a diagram) in the "Gentleman's Magazine."

The celebrated Lord Bacon, in his "Novum Organum," 1645, suggested a machine where the diver "stood upon a stool of 3 feet as a tripod, which was in length somewhat less than a man, so that the diver, when no longer able to contain his breath, could put his head into the vessel, and having breathed again, returned to his work."

Bishop Wilkins, in his "Mathematical Magic," 1648, proposes a a machine "whose benefits shall be incalculable: 1st. Privacy, as a man may go to any part of the world invisible, without being discovered or prevented. 2nd. Safety, from the uncertainty of tides and tempests that vex the surface, from pirates, robbers, and ice, which so much endanger other voyages towards the poles. 3rd. It may be used to undermine and blow up a navy of enemies, or to relieve a blockaded place." His plans were, however, wholly theoretical.

In 1663, the Marquis of Worcester published the heads of his "Century of Inventions," the necessary directions for carrying out these projects having been lost, as it is stated in his observations on the title page. Proposal 9 is—"A ship destroying engine, portable in one's pocket, which may be carried and fastened on the inside of the greatest ship, and at any appointed minute, though a week after, either of day or night, it shall irrecoverably sink that ship." Proposal 10—"Away from a mile off, to dive and fasten a like engine to any ship, so as it may punctually work the same effect, either for time or execution." Proposal 11—"How to prevent both. How to prevent and safeguard any ship from such an attempt by day or night."

In 1669 Borelli contrived a "vesica," or bladder, which was, in fact, a copper vessel two feet in diameter, with glass fixed before the face of the wearer. This contained the diver's head, and was fixed to a goat-skin habit, exactly fitted to the shape of the body. He carried an air-pump by his side, by means of which he condensed or rarified the air in the vessel, and thus made himself heavier or lighter on the same prin-

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ciple as fishes. Within this "vesica" there were pipes, by means of which a circulation of air was contrived; thus equipped, and with artificial webbing to the feet, to enable him to tread the water, the inventor supposed that he had overcome all difficulties hitherto known or objections to which such machines were liable. Hooke, in 1681, in his "Philosophical Collections," speaks of Borelli's apparatus, of which he gives a plate, as also of one which he claims to have himself constructed. This he describes as "another way of swimming under water, and breathing by the help of a leather pipe, kept open by wreathed wires, and extending from the diver's head to the top of the water." In 1678, a German named Sturm was enabled to make some further improvements in Borelli's apparatus, but neither seem to have answered the intention, or ever to have been used.

Mersennius, in his publication at Amsterdam in 1671, proposed a submarine boat, by which persons might pass from place to place under water, move it to and fro, and make it rise or sink in a river or sea; this project failed, however, like all its predecessors. Another proposal for a diving machine appears also in the same place and in the same year, from Nicolas Witsen; he describes his invention very explicitly, and gives instructions to the divers, as to its proper use and management, but there is not any account of its real utility or success.

The Duke of Argyle, among others, joined in the mania, and determined upon examining the wreck of a vessel sunk off the Isle of Mull in 1588, being, in fact, one of the Spanish Armada, and supposed to be richly laden. He engaged for the task a man named Colquhoun, of Glasgow, who went down several times, but merely surveyed the wreck as well as he could. The apparatus he employed seems to have been made after that suggested by Hooke, and consisted of a long pipe of leather by which the air was communicated, his head being covered with some sort of bell. In 1688 Sinclair, a professor in the university of Glasgow, published his principles of navigation, in which, in a postscript, he gives directions how to buoy up any ship of burden from the ground to the surface of the sea, and he speaks of the apparatus employed in searching the vessel as being similar to that which Colquhoun had previously used.

The most successful adventure of the period was undertaken by one Phipps, a ship's carpenter, the son of a blacksmith at Boston in America. He began to operate in 1687, with an apparatus, the character of which is now unknown, upon the wreck of a Spanish galleon lying off the coast of Hispaniola; but what he then recovered did not repay the outlay. Nothing daunted, he determined upon trying again, and assisted with money (though most usuriously) by the Duke of Albemarle, son of the well known General Monk, he eventually, but with much difficulty, rescued property of the value of nearly £300,000, of which sum he received about £20,000 for his own share. In other ventures he was equally successful. He was afterwards knighted, became sheriff of New England, and founded the present noble family represented by the Marquis of Normanby.

With the publication of a work by Pasch at Leipsig in 1700 the century closes. His plan was merely an alteration of others that had preceded, and was never probably tried with success.

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The celebrated Dr. Edmund Halley, Secretary of the Royal Society, paid great attention to the subject for some years, and from his continued experiments, and the very different structure of his machine, he was considered as the inventor of the diving bell; that notion has, however, long been exploded.

In 1716 he read his paper entitled "The Art of Living under Water" before the Royal Society, and the following extract conveys his views. He says—

When there has been occasion to continue long at the bottom, some have contrived double flexible pipes to circulate air down into a cavity, enclosing the diver with armour, to bear off this pressure of the water, and give leave to his breast to dilate upon inspiration, the fresh air being forced down by one of the pipes with bellows or otherwise, and returning by the other of them not unlike an artery or vein. This has been found sufficient for small depths not exceeding twelve or fifteen feet, but when the depth surpasses three fathoms, experience teaches us that this method becomes impracticable; for, though the pipes and the rest of the apparatus may be contrived to perform their office duly, yet the water, its weight being now become considerable, does so closely embrace and clasp the limbs that are bare or covered with flexible covering, that it obstructs the circulation of the blood, and presses with so much force on all the junctures where the armour is made tight with leather skins or such like, that if there be the least defect in any of them the whole engine will instantly fill with water, endangering the life of the man below.

To remedy these inconveniences the diving-bell was next thought of.

He then describes his contrivance, which was a truncate cone of wood, containing 60 cubic feet in its concavity, the diameter at the top being 3 feet, and at the bottom 5 feet. In the top was placed a strong clear glass to give light, and a cock to let out the air that had been breathed. The machine was coated with lead and otherwise weighted, that it might sink steadily; when below it was supplied with air by two barrels of 36 gallons each, which were alternately lowered and raised, full and empty. In this instrument he says that he remained without inconvenience, wholly dressed, with all his clothes on, for one hour and a half at a depth of 10 fathoms.

He subsequently conceived a method by which the diver could leave and walk about some distance. This he also described to the Royal Society in 1721. He says—

I bethought myself how to enable the diver to go out of the bell to a considerable distance, and to stay a sufficient time without it, with full freedom to act as occasion served. . . . . I procured pipes to be made which answered all that was hoped from them. They were secured against the pressure of the water by a spiral brass wire, which kept them open from end to end.

This appears to have been an adaptation of Hooke's apparatus, or of that used by Colquhoun. These tubes, of which the diameter of the cavity was about one-sixth of an inch,

were coated with thin glove-leather curiously sewed on, and then we dipped the leather into a mixture of oil and beeswax hot. Then we drew several folds of sheep's guts over them, which, when dry, we painted with a good coat of paint, and then secured the whole with another coat of leather, to keep them from fretting. The pipes, of which we made several, were about 40 feet long, the size of half an inch rope, the one end thereof being fixed in the bell, and the other fastened to a cock, which opened in the cap. . . . . The diver, therefore, putting on his cap, and coiling his pipe on his arm, like a rope, as soon as he is discharged from the bell opens a cock and marches on the bottom

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of the sea, seeing that the coils of his pipe are clear which serves as a guide to direct him back again, &c. The leaden caps were made to weigh half a hundred weight, to which I added a girdle of large weights of lead, of about the same weight in the whole, to be worn about the waist, and two clogs of lead for the feet of about 12lbs. each.

About the same time that Dr. Halley read his first paper to the Royal Society, in 1716, a person named John Lethbridge, of Newton Abbot, near Exeter, invented a machine which was made under his directions by a cooper in Stanhope Street, Clare Market, the particulars of which he published about thirty-three years afterwards in the Gentleman's Magazine. He thus describes it:—

It is made of wainscot, perfectly round, about 6 feet in length, about 2½ feet in diameter at the head, and about 18 inches diameter at the foot, and contains about 30 gallons. It is hooped with iron hoops without and within, to guard against pressure; there are two holes for the arms, and a glass about 4 inches diameter, and 1¼ thick to look through, which is fixed in the bottom part, so as to be in a direct line with the eye; there are two air-holes upon the upper part, into one of which air is conveyed by a pair of bellows, both of which are stopped with plugs immediately before going down to the bottom. At the foot there is a hole to let out water; sometimes there is a large rope fixed to the back, or upper part, by which it is let down, and there is a line called the signal line by which the people above are directed what to do, and there is fixed a piece of timber as a guard for the glass. I go in with my feet foremost, and when my arms are got through the holes, then my head is put on, which is fastened with screws. It requires 5 cwt. to sink it, and taking 15 lbs. from it, it will buoy upon the surface of the water. I lie straight upon my breast all the time I am in the engine, which hath many times been more than 6 hours, being frequently refreshed upon the surface by a pair of bellows. I can move it about 12 feet square at the bottom, where I have stayed many times 34 minutes. I have been 10 fathoms deep many hundred times, and have been 12 fathoms, but with great difficulty.

Another claimant appeared nearly at the same time in the person of Nathaniel Symons, of Harburton, near Totnes. He produced a diving machine in the shape of a boat, in which, before many hundred persons, he sank himself in the river Dart, where he remained three-quarters of an hour, and then reappeared. He complains with evident disappointment that, "though a great number of gentlemen of worth were present, he received but one crown piece from them all."

In 1724 Jacob Leupold, of Leipzig, describes an apparatus then in vogue, but of which he does not claim the invention. Later still, Martin Triewald, military architect to Frederick, King of Sweden, greatly improved upon Halley's invention, by making a machine both lighter and less expensive. In the head of his apparatus, which was of tinned copper, and which was managed by two men, he used, in lieu of plain glass, convex lenses to admit the light. He published the particulars at Stockholm, in 1732, and the description was subsequently read before the Royal Society.

About 1750 a Mr. Rowe invented a diving machine for searching wrecks, which consisted of a hollow copper vessel of sufficient dimensions to contain the body of a man, with holes at the sides through which his arms protruded. At the end of the "engine" glasses were placed, through which he could see the objects of his search. The diver was lowered by a rope, and could remain below for half-an-hour without any difficulty.

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A daring but unfortunate attempt to use a submarine vessel was made in 1774, by Mr. Day, in Plymouth Sound. So confident was he of success, that he had a small ordinary vessel prepared for the purpose according to his directions, and at the time appointed for making the experiment, all being ready, he sank the vessel and himself, in the presence of a great many spectators, but he never rose again.

In 1775 Mr. Spalding brought out an improvement upon both Dr. Halley and Triewald's apparatus, and was rewarded by the Society of Arts with twenty guineas; he was followed by Fairey, who rendered it still more complete and more applicable to the required purpose.

About the same time (1775) a Mr. Bushnell, of Connecticut, endeavoured to realise the project of Bishop Wilkins, and with the apparatus he constructed he offered the newly formed Republican Government of America to destroy the British shipping then lying in their different harbours and rivers; but, although he found it quite practicable to travel under water, he did not succeed in the rest of his design. His machine had a resemblance to two upper tortoise shells of equal size joined together, and it was capable of holding the operator with sufficient air to support him for thirty minutes. He could swim so close to the surface of the water as to approach unperceived very near any ship during the night. He could sink quickly at any depth he pleased, could rise to the surface for fresh air, and descend again at pleasure, as described in his publication of 1787.

This scheme was resuscitated in 1822 by Mr. Samuel Colt, who proposed to the Government of the United States to construct a machine which would effectually realise all that Bushnell had suggested. In order to test its utility, the Secretary of the Navy was instructed to render Mr. Colt every assistance and facility, and to appropriate 15,000 dollars for the purpose. A vessel was actually destroyed at some distance from the shore, but the means employed were not made public.

Benjamin Martin, originally a plough-boy in Surrey, but afterwards a celebrated optician and globe manufacturer in Fleet Street, published in 1778 a description of his diving apparatus. It consisted of strong leather, so prepared that no air could pass through it, fitted to his arms and legs, and had a glass window in the front part. This apparatus held half a hogshead of air, and when dressed in it he could walk on the ground at the bottom of the sea, or enter the cabin of a submerged ship and take out any valuables. He appears to have used this apparatus rather successfully. In his work he speaks of a machine for the same purpose by a gentleman in Devonshire: it is presumed that he alludes to Lethbridge's apparatus previously described.

Smeaton, in 1779, first employed the diving bell for civil engineering operations; it was used in repairing the bridge at Hexham, in Northumberland. The apparatus was an oblong wooden box, 4 feet high, 2 feet wide, and 3 feet 6 inches long. It was supplied with air by a pump fixed on the top. He afterwards constructed an improved apparatus, of which he made use in the construction of Ramsgate Harbour, in 1778. Mr. Rennie subsequently made great improvements in it, adapted it to local circumstances, and extensively used it at the works of Howth Harbour, near Dublin.

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The apparatus designed by Mr. Kleingert, of Breslau, was first described in a pamphlet published in 1798. The harness, or armour, was made of strong tin plate, in the form of a cylinder, which inclosed the diver's head and body; it consisted of two parts, that he might easily get it on. Besides this, he had a jacket with short sleeves, and a pair of drawers of strong leather, water-tight, and joined by brass hoops round the metal on the outside, so that he was relieved from pressure on all parts except the legs and arms. With this apparatus, on the 24th of June, 1798, a man named Joachim under his direction, and before many spectators, dived and sawed through the trunk of a large tree at the bottom of the river Oder, near Breslau.

At this time there were many projects of analagous character, but none particularly worth notice, except that by Robert Fulton, who first introduced steam navigation on the rivers of America. At the close of the last century he made a submarine boat or chest, which he exhibited under the patronage and at the expense of the French Government on the Seine, at Havre and Rouen, and afterwards at New York and other places in America.

In the year 1786, Messrs. John and William Braithwaite were engaged in recovering the guns from the floating batteries which were sunk off Gibraltar; and they presented eight pieces of fine Spanish ordnance to the Emperor of Morocco. In the year 1789 and 1790, they successfully searched for and recovered all the dollars and a large quantity of tin and lead from on board the Hartwell East Indiaman, lost off Bonavista, Cape de Verd Islands. This was accomplished, in depths varying from 5 to 7 fathoms, by means of Mr. John Braithwaite's diving machine. On their return from Bonavista, they negociated with the Government to commence operations on the Royal George, and they made all the necessary preparations. But, although the ship ostensibly belonged to the Admiralty, its guns were claimed by the Ordnance; hence difficulties arose between the Government departments, which induced Messrs. Braithwaite to relinquish their designs. From the wreck of the ship Earl of Abergavenny, outward-bound East Indiaman, of 1,300 tons burthen, they succeeded in recovering nearly all the cargo, and £75,000 in dollars. This vessel was lost in 1805, and after having laid under 10 fathoms water for 16 months, during which time many unsuccessful experiments were made by Mr. Tucker, Mr. John Braithwaite, by means of his peculiar diving machine (but which was not a diving bell), succeeded in raising the ship and cargo, amounting in value to many thousands of pounds. By this apparatus he was enabled to remain under water eight or ten hours at a time, and to conduct the various operations which were effected by machinery exclusively his own, and by the aid of gunpowder. The diving machine which he employed is now the property of his son, Mr. John Braithwaite (M. Inst. C.E.), who, with his brother, was present on several occasions to witness the operations.

The Plymouth Breakwater, for which many plans had been suggested, was commenced on the 12th of August, 1812, the first stones being deposited with much ceremony. In the progress of a work of such magnitude, extending over many years, and which, in fact, is scarcely yet completed, this mode of working below has been found of essential

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service, and has been adopted wherever it has been necessary to have firm and substantial masonry constructed under water. At the works for the harbours of refuge at Dover and at Alderney it is extensively used by Mr. Walker.

But perhaps one of the most striking uses to which it has ever been applied was in the demolition of the wreck of the ill-fated Royal George, sunk off Spithead, in August, 1782. In less than a month after the accident several proposals were made for weighing her, and the proposition of Mr. Tracey was selected from those of 118 candidates. It was no easy undertaking, considering that the weight of the guns, stores, &c., on board, amounted to 1,031 tons, and that she had sunk 13 feet into a bed of silt, or blue clay. After a trial of three seasons, and an expense of £12,000, borne between the Government and Mr. Tracey, the project was abandoned. Thus matters rested until June, 1817, when Mr. Ancell, of the Portsmouth Dockyard, went down in a diving bell and surveyed the wreck, as far as was practicable, in a depth of water of 10 fathoms. Another respite of 17 years then took place. In the meantime, Mr. Deane, with an apparatus which was originally intended for the recovery of property from houses or factories while on fire, but which, having failed to obtain the patronage of the insurance offices, he applied to diving purposes, succeeded, in 1828, in clearing the wreck of the Carnbrae Castle, Indiaman, lost at the back of the Isle of Wight. He also operated upon the wreck of Her Majesty's ship Boyne, burnt, at the latter part of last century, off South Sea Castle. He then offered to remove the wreck of the Royal George, and after some delay received permission to make the attempt. In 1834-5-6, having had more perfect apparatus made under his directions by Siebe, he was enabled to bring up 28 guns (of which 21 were of brass, and in good preservation), and also some other portions of the wreck.

His task being so far complete, he attempted, with success, to bring up the guns of the Mary Rose, which was lying not far from the other wreck. This vessel had been submerged for nearly 300 years, as she went down in July 1545, and its situation was only discovered in 1836 by some fishermen, whose nets had sustained injury from something protruding from the bottom of the sea. In 1836 he succeeded in raising twenty-five guns, five of which were of brass, and the other twenty of wrought iron. The brass guns bore date 1535, and the maker's names were Robert and John Owyn. The other guns were of peculiar construction, being manufactured of wrought iron bars, secured by thirty-three hoops ;* besides these, he brought up some iron and many granite shot, eight ancient bows,* a number of miscellaneous articles, and part of the oak mainmast ; the latter still in good preservation.

In 1839 the operations upon the Royal George were resumed under the direction of Colonel (now Lieutenant-General Sir C. W.) Pasley. It was determined, if possible, to clear the roadstead, although, at one time, doubts were entertained of the propriety of attempting it, unless it could be done so effectually as to entirely free the bank from all debris. The destruction of the remains by gunpowder having been resolved upon, cylinders were prepared, and being heavily charged, the first explosion

* One of these guns, and a long bow, are in the Museum of the Institution.—Ed.

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was reserved for and took place on the 29th of August, 1839, that being the fifty seventh anniversary of the melancholy event. On the 20th of September, a charge of 260lbs. of powder was fired by the voltaic battery ; and this is supposed to have been the first public practical adaptation of such means, although the applicability of the voltaic battery for such purposes had been previously demonstrated by Mr. J. Bethell (Assoc. Inst. C.E.) on the 24th of April, 1838, at the Institution of Civil Engineers. The effect was instantaneous, highly satisfactory, and grand beyond description. The surface of the water was immediately covered with dead fish and with fragments of all descriptions, curiously covered with seaweeds, and of richly tinted colours. During the season were recovered, among other things, five brass guns weighing 26,072lbs. (the value of which, as old metal, was estimated at £1,000), and seven iron guns.

In 1840 the Colonel again resumed operations, and with the same success ; having an able assistant, as a diver, in Mr. George Hall, of Whitstable, with about eighty men, including Sappers and Miners. The apparatus employed was manufactured by Siebe, by whom several alterations, at Deane's suggestion, had been made in that previously used.

By the end of 1841 much valuable timber was rescued ; indeed, between the months of May and November in that year, not less than 18,600 feet, or 372 loads of timber were brought up, and, being afterwards sold by public auction, great quantities were preserved as relics.

The season of 1842 was quite as satisfactory as those preceding, and in that of 1843, the harbour was finally cleared of all obstruction. The consumption of gunpowder during the operations was 52,963 pounds, and there were recovered no less than 581 cwt. 2 qrs. 14lbs. of various sorts of metal (exclusive of 86 guns), and 59,000 cubic feet of timber.

It may be remarked, as somewhat curious, that of all the money which must have been on board at the time of the catastrophe, when 1,200 persons went down, only two guineas were found. It is, moreover, satisfactory to know, that during the works no accident occurred, attended with loss of life or limb, although there were three or four narrow escapes. But perhaps the most singular incident is, that an actual fight took place below between two divers for the possession of some portion of the wreck claimed by both ; in the scuffle the glasses of one helmet were broken, and the diver was nearly drowned before he could be rescued. Such an accident is now, in my apparatus, effectually provided against by helmet slides.

The operations against the wreck in question also resulted in great benefit to the practice of diving, the applicability of the apparatus having been tested in every possible manner. Many of the Sappers and Miners, both of the regular Army and of the East India Company, were fully initiated in the use of diving apparatus, and sailors from different vessels were also trained so as to be useful in cases of emergency.

In France there had been many efforts towards establishing the practicability of submarine boats, but the great difficulty was how to supply air to the men employed. Dr. Payerne however felt convinced, that it was practicable, by chemical means, to restore the purity of the air under water, without communication with the atmosphere. This experiment

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was first tried in England at the Polytechnic Institution, and was then repeated with success at Spithead.

On the latter occasion the bell was accompanied by four cylinders, each four feet long and twelve inches in diameter, containing condensed air, which was forced into them by an air pump, and allowed, when required, to flow into the bell by turning a cock. Another experiment was made without cylinders; the end of one of the diver's air pipes was conducted into the bell, and air was forced through it by one of the small pumps ordinarily used for supplying air to a helmet diver. The water was kept out of the bell as well as under the ordinary system, and the respired air was renewed in a perfectly satisfactory manner. The result was approved by Lieutenant-General Sir C. W. Pasley and other scientific men, the air for respiration being perfectly good, and the whole apparatus for purifying it so compact and simple that it could be contained in a case not larger than a common portable desk, and it could be used without any trouble.

The helmet diving apparatus has now become of comparatively common use, for the repair of lock gates and other works under water. In the building of almost all docks, bridges, &c. of any extent, it is in constant use; and in examining accidents occurring to vessels, and more especially to the shafts of screw propellers, to rudders, &c., it has been very useful. It has been so constantly exhibited at the Polytechnic Institution and at the Panopticon, that it has become familiar to all.

Besides the various alterations and improvements already mentioned, there have been many others that deserve notice.

In 1835 Mr. J. Bethell introduced several important improvements in the form and use of diving apparatus.

In 1836 Mr. William Bush, of Bishopsgate, claimed the introduction of air pumps into diving bells, instead of pumping air down from above; the application of a pump to diving dresses, whereby the diver might supply himself with air from above, and the use of an air belt, combined with a diving dress, to facilitate the diver in rising and sinking. He also applied a compass to the helmet of the dress, in order that the diver might ascertain his position when below the water.

In 1836 Mr. Fraser made an improved escape valve and other additions to the dress.

In 1838 Mr. Thornthwaite, of Hoxton, produced a diving belt, for which he was rewarded with a silver medal by the Society of Arts, and his invention was ordered to be placed in their repository. His instrument consisted of a belt of India rubber cloth, to which was attached a small strong copper vessel; into this, air was forced by a condensing pump, until it had a pressure of between thirty and forty atmospheres. The belt being put on in a collapsed state, did not give any buoyancy, nor impede the diver in his descent. If he desired to rise, he opened a valve, by which the condensed air escaped from the metal vessel into the belt, and by its expansion enabled him to rise to the surface.

In the ordinary apparatus and helmet great alterations have been effected from time to time by the various makers. The improvements introduced by Mr. E. Heinke and the author, some of which are shown in figures 1, 2, and 3, are based upon long experience of the defects com-

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plained of in ordinary apparatus. The submarine dress, as manufactured at that period, was exhibited at the Great Exhibition in Hyde Park, in 1851, and obtained the award of a medal; since that time several additional improvements have been made, and so nearly perfect may the apparatus be now considered, that there are few persons who would hesitate to go down in the dress after once seeing it used.

Among the most prominent of the improvements, is that of the eye-frame, to which is affixed a brass slide, so contrived that in case of accident to the glass the diver can immediately close it, and thus save himself from drowning. A double valve fixed in the front of the gorget enables the diver to descend and rise at pleasure, with the whole of his gear, which weighs upwards of 200lbs; in fact it places the whole apparatus completely under his control, and protects him in case of anything happening to the air hose, as by its means a sufficient quantity of air, to support respiration for ten minutes, can be contained in the helmet and dress, thus giving time to ascend, even from a very great depth. The connecting joints are now so manufactured that they can scarcely be broken, as they will resist the most powerful pressure, in consequence of having a double safety cap affixed.

The new vulcanized band completely excludes the water from the dress, and enables it to fit more easily and with greater comfort to the wearer. The signal dial makes the wants of the diver known to those above, instantly and correctly, and, in fact, renders the apparatus nearly complete for the most difficult undertakings.

A woodcut is subjoined, showing a section and elevation of one of Heinke's helmets, as also a sectional view of the valve. Fig. 1 shows a front elevation of the helmet itself. It will be seen from this that the openings are also provided (as an extra safety-guard) with segmental plates, so that, by turning either disc round by means of the buttons which project from the circumference, the openings can be closed instantaneously. The regulating or safety-valve is seen in front of the helmet, just below the joint indicated by the letter A, which joint enables the whole top of the helmet to be taken off at pleasure. Fig. 2 shows a section through the head-piece, exhibiting the pipe at the back, through which the air is fed down the valve for safety in the event of the bursting of a feed pipe. From the orifice will be seen the tubes, extending over the upper internal surface of the helmet, for leading the stream of air over the glasses; and again below, and marked by the letter B, will be seen the safety-valve before-mentioned, which can be opened or shut at pleasure by the diver. This valve is shown in section on a larger scale in Fig. 3. It will there be seen that an ordinary valve, which is held in place upon its seat by means of a spiral spring, is covered with a cap perforated on the top, so as to allow of the escape of such air as passes, but so fitted as to turn upon the outside of the valve-box or seat at pleasure; this is provided with a long slotted hole, which runs some distance around its circumference, and the lower part of the valve-seat or box is provided with a similar slot. From this description it will be apparent that the cap can be turned, so as either to let the two holes be in one, and thus open to allow of the escape of the air, or be closed, should it be desired; by this simple contrivance the diver can regulate the egress of the air, and so, the extent of the supply,

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FIG. 1.

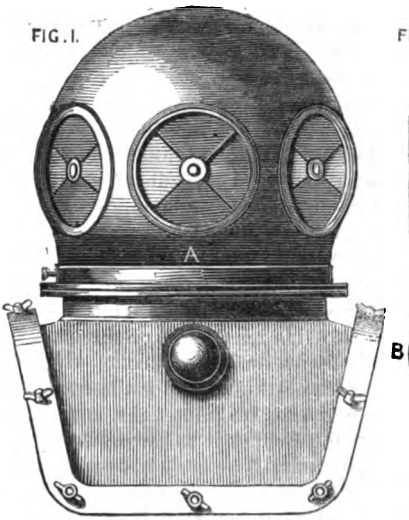


FIG. 2

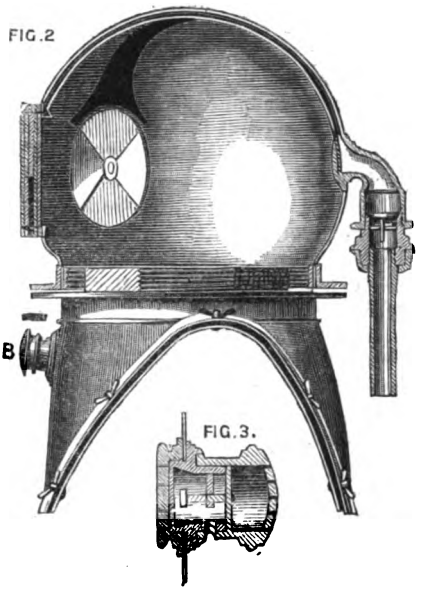
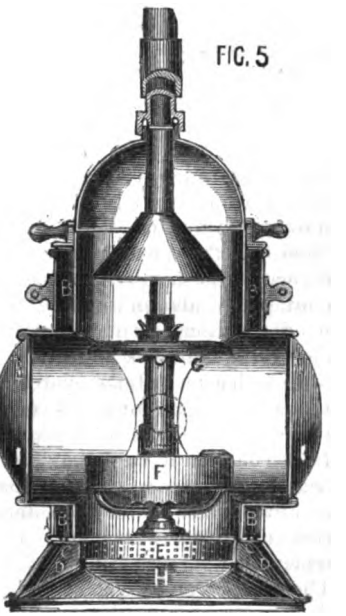


FIG. 3.

FIG. 4

FIG. 5



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to the greatest nicety. Figs. 4 and 5 show a side elevation and longitudinal section of my lamp, which, it will be noticed, possesses the following peculiarities and advantages. The amount of air which is supplied through the pipe A, Fig. 4, can be regulated by means of the tap; the air thus admitted flows into the external ring or case, which is shown by the letters B B in the sectional elevation, Fig. 5; it then finds its way through the perforated plate C C, at the bottom of the ring, into the receptacle D D, and thence through the strainer E into the lamp itself, for the support of combustion. The burner itself is of the form commonly called Argand, and supplied with oil or gas from the ring F, which is made open, so as to allow of the light from the lamp being thrown down from the reflector G, through the lense H, so that by this means the bottom surface of the sea can be examined without removing the lamp from its upright position. The lamp is also provided with two side lenses I I; or three can be used if required. The upper cap is fitted with an internal cone, which is connected with a pipe leading to the surface of the water for the escape of the products of combustion. This lamp gives a brilliant light, and the air supplied percolating through the lower ring enables it to burn steadily, a matter of considerable importance in such cases.

In 1855 a number of interesting trials took place with my apparatus in various places. The experiments which were conducted at Portsmouth, in the month of June, in the presence of the Admiral Superintendent and Dockyard officers, gave great satisfaction; the diver remaining below, half an hour at a time, in a depth of water of 3½ fathoms. At Chatham dockyard, in October, a similar trial took place, in the presence of the Captain Superintendent and several gentlemen connected with the establishment, as well as many officers of the corps of Royal Engineers and others, who all expressed their gratification at the result of the experiment.

At Paris it was tested on the Seine, by command of the French Government, and in the presence of Prince Napoleon, a large number of military and other engineers, the Commissioner-in-Chief, the Secretary of the Exhibition, and the members of the International Jury. On that occasion five kinds of diving dresses were tried (of which three were English and two were French) in every variety of situation. The apparatus which was attended with the most succesful results, and which it was decided possessed the greatest facilities, was that exhibited by myself. The diver, without any assistance, raised himself to the surface by partly closing the valve in the breastplate of the helmet; the compressed air thus filled the waterproof dress, and brought him up. When he wished to descend he had only to turn on the air valve.

In order to test the alertness of the divers twelve small rings were thrown into the river; of these my diver picked up ten, and the other two were not found by any of the divers. Again, at the request of Prince Napoleon, he went down with a helmet, the glass of which had been accidentally broken at the Westminster Bridge works, and which, of course, admitted water; he immediately closed the safety valve as directed, and remained under water half an hour, before coming to the surface. The under-clothing was then examined, and was found to be perfectly dry. The divers representing the other makers were then requested to submit their apparatus to the same test, but they all declined. The French

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exhibitor, M. Ernoux, at once and in the most handsome manner acknowledged the superiority of Messrs. Heinke's apparatus, stating that he considered it really perfect.

At the close of the Paris Industrial Exhibition, a first-class medal was awarded for the apparatus, which was transferred to the Crystal Palace at Sydenham.

Mr. PEPPER said, as far as he had examined the lamp he should say it was a very valuable and practical instrument. At the Polytechnic Institution he was most anxious to illuminate the operations of divers. The ancients had a great idea of a lamp which was to illuminate their tombs for ever; but they seemed to have lost sight of the principles which Mr. Heinke had carried out in his lamp. Suppose a lamp shut up in a subterranean place, supplied with fuel to burn for a long time, it must be extinguished by the carbonic acid gas. Now Mr. Heinke provided for that by forcing in a constant supply of fresh air. Again, the ancients had to provide a material which would burn for ever, but Mr. Heinke provided a lamp which anybody could trim and use at pleasure. He had himself tried to apply the oxy-hydrogen light for submarine purposes. It was provided with a double cylinder of glass, and answered remarkably well in his hands. It was then placed in the hands of attendants, and they soon afterwards reported to him that they had had a dreadful accident, and that the lamp was blown out. The next light he tried was the electric light of M. Du Boscy, of France. While that gentleman remained in England to superintend the operations, the lamp answered remarkably well, but the gentlemen in whose charge it was left were unable to carry them out. These two lamps were accordingly put aside. Now, if they were provided with this simple apparatus of Mr. Heinke, which was provided with common oil, and when let down into the water supplied with fresh air, he was sure it would answer remarkably well.

Captain NOLLOTH reminded Mr. Heinke of the submarine operations of Captain Dickenson, who recovered nearly a whole cargo of dollars. The ship's tanks were ingeniously converted into divingbells, and with these Captain Dickenson carried out his operations.

Mr. HEINKE said the lamp had been extensively used at Westminster bridge. The water there being thick, they could only see about eighteen inches or two feet, but it enabled the engineer to examine the granite, and to see if the divers had done their work in a proper manner. At Dovor, the water not being so thick, but of a light, milky hue, caused by the admixture of chalk, they could see nine or ten feet all around. It was of great assistance, and was used extensively. The same with the diving apparatus, which was superior to the diving bell to this extent, that a diver could lay eight large blocks of stone, each block weighing about 7 tons, in four hours, whereas with the diving bell he could only lay 5 at the most.

The CHAIRMAN asked Mr. Heinke if he had seen any of the tubes used with a glass end to them, for seeing under water.

Mr. HEINKE said he had not. He thought Mr. Bethell had a kind of funnel which he dipped in the water to a certain extent. Where the water was not very thick it would answer, but at Westminster bridge it would be impossible to use it. The engineer in charge of the works, Mr.

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Harris, made a point of going down every day to see if the divers had done their work properly. His apparatus had been in use these four years and a half, and all the under-water work had been done by means of it, without a single accident.

The CHAIRMAN asked whether the machinery for the diving apparatus was not less than that required for the diving bell.

Mr. HEINKE replied it was. He recommended that every ship of war should be provided with one of his apparatus.

The CHAIRMAN asked what was the expense?

Mr. HEINKE replied, with all the improvements it would cost about £140, and that the diving apparatus would cost about £7 per week for working expenses, whilst the diving bell would cost from £18 to £22.

The CHAIRMAN moved a vote of thanks to Mr. Heinke for his communication. It was a very important one. The simplicity of the lamp must make it succeed; there was nothing complicated about it. Deane's apparatus was likely to get out of order. He saw a case at the Cape where they wanted to use it but could not.

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The Journal

OF THE

Royal United Service Institution.

VOL. IV. 1860. No. XIII.

LECTURES.

Friday, March 30, 1860.

General H.R.H. THE COMMANDER-IN-CHIEF in the Chair.

THE MILITARY CHARACTER OF GENERAL SIR CHARLES J. NAPIER, G.C.B.

By Col. MACDOUGALL, Commandant, Staff College.

THE life of Sir Charles James Napier, which forms the subject of this address, was so full of strange perils and marvellous escapes, so illustrated by greatness of soul and greatness of action, that it would almost seem more properly to belong to the age of romance; and I must bespeak the indulgence of my hearers on account of the inability I feel to do justice to a subject of so much interest in the limited time at my command.

Truly is it said of Sir C. Napier by his biographer, that "His is the story of a man who never tarnished his reputation by a shameful deed; of one who subdued distant nations by his valour, and then governed them so wisely, that English rule was reverenced and loved where before it had been feared and execrated."

It will be my endeavour in this address to show, imperfectly it must be, that in these words there is no exaggeration.

Passing over his childhood and youth, which yet abound in strangely interesting incidents, it was not till he was a Major in the 50th, which regiment he commanded in the action, that he first saw war in earnest at

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Corunna. I do not believe there exists a more graphic description of exciting and terrible events, than the record he has left of his personal share in that battle.

I can only regret that time does not admit of my reading the narrative as set down in his journal, for, although desperately wounded—his ankle broken by a bullet—stabbed in the back—and engaged in a struggle for his life against numerous enemies, during which he received another severe wound from a sabre cut on his bare head—he was yet able to observe and to record the minute events of the day with a simplicity, a force, and a self-evident accuracy, which under the circumstances are truly astonishing.

Made prisoner at Corunna and released by the generosity of Marshal Soult, for which good deed the whole Napier family during their lives cherished towards the Marshal the warmest gratitude,—Major Napier was present as a volunteer at the action of the "Coa," and, with very unaccustomed good fortune, escaped on that occasion unwounded. His remarks, made at the time, on Craufurd's errors, are well worthy of study, and show to what an extent he had already mastered his profession.

At Busaco, again a volunteer, he received a terrible wound, from the effects of which he suffered tortures during the remainder of his life; a bullet having passed through his nose, broken the left jaw, and lodged near the ear. The operation for the extraction of the ball was frightful, which however he treated as lightly, according to the testimony of his cousin who was present, as the drawing of a tooth. When it was over, he was with difficulty prevented by Sir E. Pakenham from rushing back into the fight, with his jaw broken, and blood flowing from his mouth.

His two brothers, George and William, were in the battle and had heard of his wound; but sent him word that they could not come to see him.

"How proud and happy," he says in his journal, "this message made me. I gloried in them; yet, thinking I could not live long, I was very anxious to see them, especially as I heard George had been wounded while gallantly leading a charge. William had been shot through the hip two months before, but did not go to the rear, and went into action here with the wound still open. Well, we are all three still alive, and old men: we were then young, strong, and as hardy men as any in the army, and we had fifteen or sixteen wounds between us, and being very fond of each other it made a talk among our comrades."

Again we find Major Napier with his wound still bandaged, riding ninety miles in one day to join his regiment, forming part of the force with which Wellington pursued Massena. His two brothers were in the Light Division which led the advance, and which was almost hourly engaged with the French rear-guard under Ney.

Thus advancing, he met on one occasion a litter of branches being carried to the rear; on asking the bearers what wounded officer they carried, the reply he received was "Captain Napier, 52nd, with a broken limb." A second litter followed, and he was told that *its* occupant was Captain Napier, 43rd, "mortally wounded," as it was supposed at the time. He only looked at them and passed on to the fight in front.

At the conclusion of the war Charles, then Lieutenant-Colonel Napier, entered the Military College at Farnham. His brother William was there at the same time. The motives which induced these men, who had served

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with so much distinction in the field, to shut themselves up for two years within the walls of a college, are well set forth in a letter of advice which thirty years later the Governor of Scinde addressed to a young officer :—

"By reading, you will be distinguished; without it abilities are of little use. A man may talk and write: but he cannot learn his profession without constant study to prepare, especially for the higher ranks, because he there wants the knowledge and experience of others improved by his own. But when in a post of responsibility he has no time to read; and if he comes to such a post with an empty skull, it is then too late to fill it, and he makes no figure.

"Thus many people fail to distinguish themselves, and say they are unfortunate, which is untrue. Their own previous idleness unfitted them to profit by fortune."

In 1822, Colonel Napier was appointed Military Resident at Cephalonia, which gave him despotic power over the island, as Lieutenant of the Lord High Commissioner. "Besides being King," he says, "I am bishop also, and all the convents and churches are under me; the priests cannot kill a fowl without my written order." The work was excessive. "My predecessor," he wrote, "is going home half dead from the labour; but to me, it is health, spirit—everything. I live for some use now. I take no rest myself, and give nobody else any." Indeed, his labours for the improvement of the Cephalonians were as incessant and as successful, as they were afterwards, on a larger scale, for the regeneration of Scinde. They were cut short in 1830, in consequence of a disagreement with the Lord High Commissioner; but the best testimony to the beneficence of his rule is to be found in the fact, that after he had quitted Cephalonia for ever apparently in disgrace with the Supreme Governor, the peasants of that island voluntarily cultivated a small piece of land, left by him uncared for, and transmitted to him yearly the value of the produce.

I shall have to relate a parallel instance which occurred twenty years later, when he was quitting India for the last time at enmity with the Indian Government.

In 1839, Major-General Sir Charles Napier was selected for the command of the Northern district, at the time when the Chartist agitation was at its highest and an outbreak seemed imminent; and the details of his proceedings in this anxious post—his sagacity—his forbearance—the tact with which he reassured the over-timid, and restrained the over-violent—are full of interest and instruction.

During his Northern command Sir C. Napier's health began to give way. He fancied himself threathened with blindness, and complains occasionally in his journal of the unendurable agonies he suffered—the consequence of his Busaco wound. He evidently believed that he was failing—that his work was well nigh done—and that his character and ability must be judged by the deeds of his past life. He little thought that the most brilliant part of his career lay in the future—that opportunity would yet be afforded him to prove that his ability both for war and for government were of the very highest order; and that he only wanted equal opportunities to become the rival in renown, as I verily believe him to have been the equal in genius, of the greatest captains of the world.

It is strange to observe how late in life the great work to which they seem

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born comes to some men. Appointed Major-General on the Bombay staff in 1842, Sir C. Napier was sixty-two when his selection by Lord Ellenborough for Scinde first gave him an independent military command.

Scinde was at this time still heaving with the swell occasioned by the Cabool disaster, and agitated with hatred to British authority.

I am not here to consider the justice or policy of the conquest of Scinde. That conquest was effected by Sir C. Napier as an executive officer in the unquestioned discharge of his duty, with a rapidity, a completeness, and a clemency, almost unparalleled in history, and whose effects have been as enduring as they have been beneficial to the conquered race.

It seems to have been Sir C. Napier's destiny to be placed continually amid scenes of terror and suffering, and to experience marvellous escapes from deadly peril. No sooner did the steamer, in which he now embarked at Bombay for Kurrachee, gain the open sea, than cholera broke out on board in its most frightful form.

In the six "bitter days and nights," as he calls them in his journal, during which the voyage lasted, fifty-four dead bodies were cast into the sea, just one-fourth of the whole living freight; eighty more were seized, of whom ten died after landing. To crown all, the steamer nearly went ashore on a dark night, when making the land, owing to the drunkenness of the two mates.

Escaped from these dangers, the ill-timed explosion of a rocket, four days after he landed, tore the calf of his leg open to the bone and inflicted what might have been a very dangerous injury; but the wound healed, as doctors say, "by the first intention," owing probably to his remarkable temperance both in eating and drinking, and five days afterwards he was travelling towards Hydrabad.

Scinde was at this time in a very disturbed political state. It was inhabited by three distinct races, Beloochees, Hindoos, and Scindians proper. The Ameers, princes of the land, were chieftains over the Beloochees, tyrants over the other two.

A treaty, concluded by Lord Auckland three years before, gave to the British control as a paramount power over the Ameers, and the right of military occupation of certain places in Scinde; but when Sir C. Napier arrived, the Ameers, encouraged by the recent Cabool disaster, were exciting the mountain tribes to war and preparing for it themselves.

It was precisely at the time when, to re-establish British prestige, General Nott advanced from Candahar to join General Pollock at Cabool, with orders afterwards to retire to India by the Khyber pass, while Colonel England with a part of Nott's force fell back into Scinde by the Bolan pass. While the troops were thus dispersed, the safety of England's column, and British supremacy in Scinde, evidently depended on the capacity of Sir C. Napier as a politician and a commander.

The places occupied by the British under the treaty, were Sukkur, Roree, Shikarpore, and Kurrachee.

The possession of Sukkur and Roree afforded a secure passage of the Indus from either bank, and was of great stragetical importance; not only because it enabled the General to operate by either bank of the river at will, but because those places constituted a base of operations for the British force, which could thence communicate with the British North-west pro-

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vinces and the Bengal army, through the friendly territory of the ruler of Bhawulpore.

When Sir C. Napier assumed the command, the force in Scinde did not exceed 4,000 men, and was about equally divided between Sukkur and Kurrachee; that is to say, 400 miles asunder, with insecure communication. The remainder of the troops intended to form his army were with Colonel England, approaching Sukkur by the Bolan pass; when these joined, as they did shortly after, his force amounted to about 9,000 men of all arms.

All the Ameers both of Upper and Lower Scinde, with the exception of Ali Moorad, had entered into a league against the British; but it was their great object to postpone a rupture for two reasons.

1st. To gain time for the assembly of their troops; and they could bring together, if time were given them, between 70,000 and 80,000 men.

2nd. To defer military operations to the approaching hot season, when the sun would prove their most powerful ally.

Every artifice was therefore employed to deceive the English General as to their intentions.

Sir C. Napier was thought fortunate in having, at this crisis, the assistance of an experienced Indian officer as political agent, who had spent his life in unravelling the threads of Indian intrigue, and was generally supposed to be a master of the art.

But repeated infractions of the treaty by the Ameers, and the certain information that they were secretly assembling their troops, convinced Sir C. Napier, although these facts failed to convince Major Outram, the political agent referred to, that those princes only waited their opportunity to attack him. He wrote this opinion to Lord Ellenborough as early as the 30th November, and on the 26th December, before his enemies' plans were ripe, he took advantage of a fresh violation of the treaty to march suddenly on Khyrpore, the capital of Upper Scinde, with 3,000 men and 18 guns.

Dismayed by this act of vigour, the Ameers of Upper Scinde went off to join their friends in the south with their fighting men, their families, and their treasures.

Thus Upper Scinde was cleared of enemies, but the task which remained to the English General was by no means easy. It was now the beginning of January. The hot season began in March, after which military operations was only another term for death to European troops. Sir C. Napier's intelligence department, in the organization of which he has never been surpassed, gave him certain information that the Belooch tribes were mustering about Hydrabad; and that place, which must be his object, was 150 miles distant. He had at his disposal in all Scinde only 9,000 men, of whom at least three-fourths were Sepoys. 3,000 was the largest number he could bring into the field, after providing for the garrisons of Sukkur, Roree, and Kurrachee, on account of the impossibility of procuring transport; the dread of the Ameers being over the contractors, so much so that the principal contractor forfeited his deposit rather than incur their vengeance.

Sir C. Napier now learned that the Ameers had thrown a garrison of 2,000 men into Emaum-Ghur, a strong fort situated in the heart of the desert, on the flank of his line of march towards Hydrabad.

If he marched on Hydrabad, he would encounter the principal Belooch army supported on that fortress, and having Meerpore and Omercote, for-

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tified places in the desert, to retire upon, while the troops from Emaum-Ghur, in all probability strongly reinforced by fresh tribes, acted on his rear and cut off all communication with Roree. And there was every reason to believe that if the Ameers gained an advantage however slight, the Affghans and Sikhs, who were watching the progress of events, would take part in the war.

Weighing all the chances, Sir C. Napier resolved to reduce Emaum-Ghur. This fort, armed and provisioned by the Ameers to serve as a base for the Belooch army of Upper Scinde, was supposed, from its position, inaccessible to European troops, and from its strength impregnable. Situated in the very heart of the waste, eight long marches from the edge of the desert, its exact position was unknown. The tracks by which the troops must move to reach it, and the wells on which their existence depended during the march, must be pointed out by native guides, and these men might be traitors. Several thousands of wild horsemen, too, hovered about the edge of the desert, able to fill up the wells or poison the waters, and watching to fall on the fainting soldiers.

These were the difficulties. But both the moral and physical advantages of success promised to be so great that the General determined on the enterprise.

Reports of the depth of sand and scarcity of water along the route he must take having convinced him of the impossibility of operating with a large force, he selected 200 irregular cavalry, picked 350 of the hardiest and most active men of the 22d regiment, and put them on camels, loaded ten camels with provisions, eighty with water—and with this handful of men and two breaching howitzers, he marched on the evening of the 5th January.

Next day forage failed, and water became scarce. He sent back three-fourths of his cavalry, retaining only fifty, and resolute to proceed so long as he could keep a hundred men together.

On the eighth day, having during their anxious march lived from hand to mouth, uncertain each morning whether water would be found in the evening—and several times it was not found—the little force reached Emaum-Ghur, where the justness of the General's calculations was at once apparent, for the Belooch commandant, with a strong fort well armed and provisioned, and having a garrison six times as numerous as the force moving against him, was yet so panic-struck by the audacity of the English general, that he had evacuated the place two days before, leaving all his stores of grain and powder behind him.

Sir C. Napier destroyed this fortress, retraced his steps through the desert, and joined his main body at Peer-Abu-Bekr, where it had been ordered to await him, on the 28rd January, without the loss of a man—without even a sick soldier—having completely effected his object, having destroyed once and for ever the confidence of his enemies in their desert as a protection, and baffled their plan of campaign.

It was now Sir C. Napier's business to persuade or to force the Ameers formally to sign a new treaty, which had been imposed upon them by Lord Ellenborough as a penalty for their repeated violation of the first, and which new treaty they had signified their readiness to accept with many protestations of loyalty.

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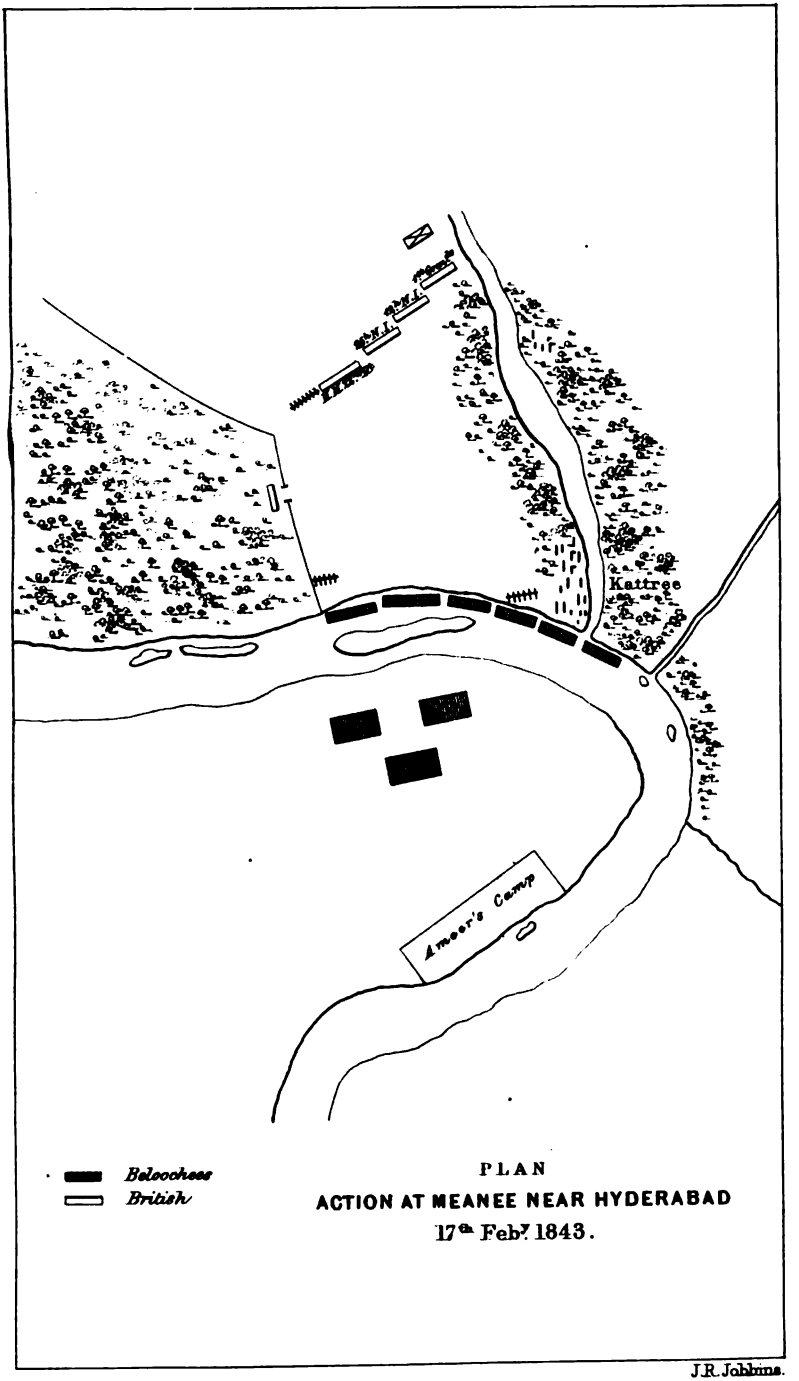

PLAN

ACTION AT MEANEE NEAR HYDERABAD

17th Febr. 1843.

J.R. Jobbins.

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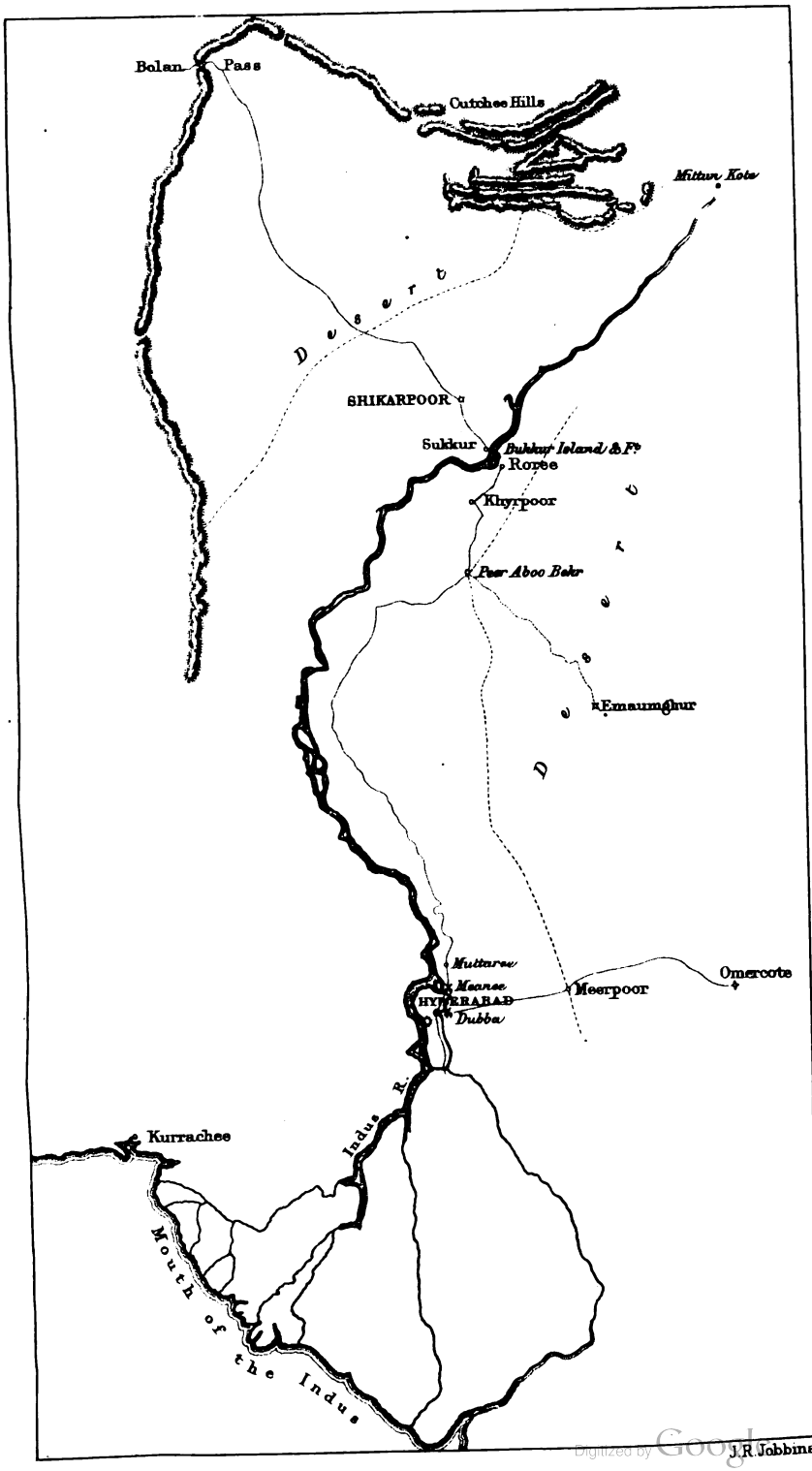

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J.R. Jobbins

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The Ameers temporised; Sir C. Napier threatened to march against them instantly if they did not sign; but deferred the execution of this threat at the urgent entreaty of Major Outram, who expressed the fullest confidence in the peaceful intentions of the Ameers, and in their submission to his demands.

But the hot season was drawing on, and it became necessary to put an end to all uncertainty. The 25th January was fixed as the last day for the signing of the treaty, and, that day having passed, the General marched towards Hydrabad.

His military position was now secure and commanding. His field force was about 3,000 strong, based on Sukkur and Roree, with a division of the Bengal army in reserve at Bhawulpore, forming a link between him and the British North-west provinces. His right rested on the Indus, on whose broad waters floated his armed steamers and supplies. His left rested on the desert, which was swept by Jacob with his Scinde horsemen, and where the enemy no longer possessed a strong place whence they might threaten his flank and his communications.

Sir C. Napier halted sixty miles north of Hydrabad, and, anxious to avoid bloodshed, he gave the Ameers to the 6th February to ratify the treaty. He even extended the time six days beyond that date, viz. to the 12th February, to enable Major Outram to proceed to Hydrabad to try the effect of his personal influence with the Ameers, which that officer was convinced would be successfully exerted.

Let me here pause in my narrative to recall the scene in the House of Commons, where a noble Lord opposed the vote of thanks to Sir C. Napier, on the ground that he had needlessly and wickedly pushed on hostilities for the sake of military glory. Now what was the fact? Here at the most critical period—when the General had certain information that the fiery cross had passed through the land, and that the Belooch clans had gathered, and were still gathering, round Hydrabad—when the foemen actually assembled outnumbered him by eight to one—so earnestly desirous was he to avoid bloodshed, that he risked the safety of his army, the prestige of the British name, and in all probability British supremacy in the East, by according a delay of seventeen days to the Ameers, which he felt morally certain would be employed against him by the assembly of thousands of additional enemies.

What should we not have heard of Sir C. Napier's facile credulity and weakness in granting this delay, if he had been beaten at Meanee?

These things are of the past, and the English nation unmistakeably pronounced its verdict at the time; but I cannot refrain from here saying, that the accusation solemnly made on the occasion I have referred to, against an absent general, who was literally wearing out his life in his country's service, was as shameful to the accuser as it was false in fact.

The most convincing disproof of this accusation is supplied by this fragment of a newspaper which I hold in my hand.

By the adverse statements of his enemies, the thanks of the Houses of Parliament to Sir C. Napier and his army for the victories of Meanee and Hydrabad were delayed for a whole year, in order to give time for the most searching inquiry; that inquiry having been made, Sir Robert Peel, in February, 1844, in moving a vote of thanks, used the following language:—

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"In his opinion there was conclusive proof, that if Sir C. Napier had passed one day inactively, or if he had attempted to retreat, or if he had not taken that course which his own wisdom combined with his military skill had pointed out, not one day could have elapsed without the army being cut off; and a disaster would have occurred of which, following so closely on that of Cabool, the consequences it would be difficult to surmise. But estimating the conduct of Sir C. Napier, he must say he did not think his chief praise was his military knowledge or his personal valour: he thought his chief praise was this, that, seeing the position in which he was placed, he well and deliberately considered all the consequences likely to ensue;—that, knowing the shock to the British Empire in the east, the danger that was incurred, the injury to its reputation from the disaster of Cabool, he, on his own responsibility, with less of local knowledge, with less of local experience, than those by whom he was surrounded, had the moral courage to act in opposition to their advice, and to that the army owed its safety."

On the 13th, in answer to Major Outram's renewed entreaties for further delay, written from Hydrabad, the General declared he would wait no longer, saying—"I have delayed at risk of the lives of my men, and of my own character as an officer, not to the eleventh but to the twelfth hour. If men die in consequence of my delay, their blood may be justly charged to my account."

On the 15th, the dream of Major Outram was rudely broken by an attack made upon his Residency at Hydrabad, by 8,000 Belooch warriors. His little escort, formed of the light company of the 22nd, after holding the post successfully for several hours, was drawn off on board steamers which the foresight of the General had despatched to Hydrabad, and steaming up the river, joined Sir C. Napier on the 16th at Muttaree, at which place he had arrived on his southward march.

Sir C. Napier knew that an overwhelming Belooch force was at Meanee, and its numbers were being hourly increased. He resolved to attack them at once. He had read the Duke of Wellington's remarks on Colonel Monson's disastrous retreat before the Mahrattas, and drew from them the conclusion never to give way before barbarians. "Let the Beloochees be sixty or one hundred thousand," he said, "I will fight."

Before daybreak on the 17th he marched. At eight o'clock in the morning his line was formed in front of the Belooch position, which was very strong and defended by 30,000 men, 5,000 being cavalry.

The Ameers' front extended 1,200 yards along the dry bed of the Fulailee River, the banks of which, sloping gradually down towards the plain in front like a glacis, afforded the infantry which lined them all the defence of a parapet.

The Ameers' left rested on a shikargah, or hunting forest, which was inclosed by a high wall having only one opening, a gateway, about midway between the Belooch and the British lines, that is to say, about 500 yards from each; and in this shikargah 5,000 of the enemy's matchlock men were posted to sally out on the right rear of the British, so soon as they should be engaged with the Belooch main body in front.

The Ameers' right was also protected by a shikargah, which was intersected by deep nullahs running at right angles to the Fulailee.

Their guns, fifteen in number, were in two masses on the flanks, and their

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camp and cavalry were placed in a loop, formed by a sudden bend of the river to the rear.

At nine o'clock the British line advanced to the attack in echellon of battalions; the right, composed of two batteries and Her Majesty's 22nd regiment, being in front. The General's quick eye instantly detected the danger to which his right flank was exposed from the 5,000 matchlock men in the inclosed shikargah.

He rode near the wall, found it about ten feet high, not loopholed, and then, riding through the opening under a play of matchlocks, he observed there was no scaffolding to enable the enemy to fire over the top.

"Then," in the words of the historian, "the inspiration of genius came to the aid of heroism. Taking the grenadiers of the 22nd, he thrust them at once into the opening, telling their brave Captain Tew, that he was to block up that entrance; to die there if it must be, never to give way! And well did the gallant fellow obey his orders; he died there, but the opening was defended."

As the British closed to within 100 yards of the enemy, the voice of the General was heard along the line commanding the charge.

The guns on the right were run up into a position, whence they swept the dense masses of Beloochees diagonally.

The 22nd were on the top of the bank in a moment, thinking to bear down all before them; but they paused in amazement at the forest of swords waving in their front, which had been up to that moment concealed from their view by the elevated river bank.

It would be a desecration to attempt to convey the scene in any other than the language of Sir William Napier:—

"Thick as standing corn, and gorgeous as a field of flowers, stood the Beloochees in their many-coloured garments and turbans; they filled the broad deep bed of the Fulailee, they clustered on both banks, and covered the plain beyond. Guarding their heads with their large dark shields, they shook their sharp swords beaming in the sun; their shouts rolled like a peal of thunder, as with frantic gestures they rushed forward, and full against the front of the 22nd dashed with demoniac strength and ferocity. But with shouts as loud and shrieks as wild and fierce as theirs, and hearts as big and arms as strong, the Irish soldiers met them with that queen of weapons, the musket, and sent their foremost masses rolling back in blood."

The battle lasted for three hours, and there was danger of the British becoming physically exhausted by the efforts necessary to repel the constant rushes of fresh opponents.

Under their repeated attacks even the 22nd were forced several times to give ground, but always their General was there to cheer and rally them. He remained during the whole of this conflict on horseback between the opposing lines, which were often not more than fifteen feet apart, and running nearly as much risk from the muskets of his own soldiers as from the matchlocks of the enemy. He exposed himself to greater danger than any man in his ranks, because he saw that it was a necessity; the 22nd were young soldiers, and if they had given way the battle would have been lost, and with it perhaps the British rule in India. But at his voice and demeanour their strength returned and they recovered their ground, though nearly deprived of regimental leaders, for those leaders had gone down fast, falling as British officers should, and always will do, when they cannot advance.

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Milton's grand lines are so applicable to the English leader on this occasion that I cannot refrain from quoting them:

> "If once they hear that voice, their liveliest pledge
> Of hope in fears and dangers; heard so oft
> In worst extremes and on the perilous edge
> Of battle when it raged; in all assaults
> Their surest signal; they will soon resume
> New courage and revive."

In every battle there is a critical period which offers victory to that commander who first perceives it, and most promptly seizes the occasion. That crisis had now arrived. Jacob's horse having vainly attempted to penetrate the shikargah on the Belooch right, with the view of turning that flank, Sir C. Napier sent orders to the whole of the cavalry to charge in one mass full on the enemy's right. Dashing through the Belooch guns, the troopers crossed the bed of the river, charged with irresistible fury on the dense masses of the enemy drawn up in the plain beyond, and spread confusion along the rear of the Belooch line engaged in the Fulailee.

Then at last the Eastern swordsmen wavered, and, pressed by the British, began slowly to retreat, not in panic or confusion, but in such large masses and with so determined a bearing, that the General did not deem it prudent with his exhausted troops to push the pursuit far.

Such was the battle of Meanee; and if we consider the individual bravery and strength of the Belooch warriors, and their numbers—for certainly not less than 28,000 were present on the field—as well as the strength of their position; when we remember that Sir C. Napier's force engaged did not actually number more than 2,000 men, and the remarkable fact, that of these only 800 were Europeans, we must conclude that this was one of the most extraordinary battles that ever was fought.

Next morning, in answer to a summons from the General, so astounding was the moral effect of the victory, that six sovereign princes gave themselves up as his prisoners, and yielded the strong fortress of Hydrabad with its large treasure.

In Sir C. Napier's despatch, the names of private soldiers who distinguished themselves in battle were for the first time published to their countrymen; and for this cause, if for no other, his memory ought always to be dear to the heart of the private soldier.

The battle had been won, and Hydrabad occupied, yet the situation of the victor was one of no small difficulty.

His force was considerably reduced, yet he was obliged to detach 500 men to garrison Hydrabad; for that place was too far from the Indus, by which alone he could receive his supplies, to serve as a base or even as a depôt, because he had not carriage sufficient to transport his stores over the four miles of road which separated the fortress from the river.

A fresh Belooch army was gathering at Meerpore under Shere Mahomed; and the hot season was coming on apace, the mercury already indicating 112° in the shade.

The British General, hitherto so daring, suddenly became the most cautious of commanders. He judged that if he marched at once against Meerpore, the Ameer would retire to Omercote, to entice the small British

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force to its destruction from heat and sickness in the desert. But an appearance of timidity on his part would encourage Shere Mahomed to come to attack him, the very thing the General desired. Meanwhile he would gain time for the arrival of reinforcements from Kurrachee and Sukkur.

He accordingly entrenched a camp on the Indus to protect the steamer station, and to serve as his base; and in it he placed his hospitals and stores. But while thus presenting an appearance of timidity to his enemies, he was careful to guard against its affecting the minds of his own soldiers, by neglecting to avail himself of the protection of his camp, and obliging the troops to pitch their tents outside on the open plain; by this, and by other means, leading them to believe that he held the Ameer's army in contempt.

The weak British force now shewed like a small rock in the midst of a rising flood, which threatened to submerge it.

Shere Mahomed, at the head of a force whose numbers were variously reported between twenty-five and forty thousand men, advanced to within ten miles of Hydrabad, loudly boasting that he would "Cabul" the British.

All the hill tribes, encouraged by the confident bearing of the Ameer and by the apparent timidity of the British General, were preparing to descend into the plains.

Dawks were stopped and stations plundered. The reinforcements which the General expected from Sukkur ran great danger of being cut off and destroyed by the Ameer, whose position commanded the line of march of those reinforcements, at the same time that it threatened Hydrabad and the British camp on the Indus.

The situation of the English General was now full of anxiety.

His field force, reduced by battle and sickness to 2,000 men, had to perform a duty beyond its capacity; that is to say, it was required to garrison Hydrabad, to defend the camp on the Indus, four miles distant from that fortress, and to guard a large pleasure garden, half a mile from the camp, where the captive Ameers were confined; while a hostile army of 25,000 men occupied a central position only ten miles off whence it threatened at once these three fractions into which the British force was of necessity divided, and the reinforcements which were marching to join it.

It was not alone necessary to ensure the safe arrival of the reinforcements; but they must arrive, and Shere Mahomed's army must be beaten and dispersed, by the 25th March; because between that date and the commencement of the unendurable heat, barely time enough would remain for the reduction of the Ameer's fortresses of Meerpore and Omercote, without which he would be able to renew the war at any moment.

Without entering into details, which are however well worthy being studied, it must suffice to say, that, by a series of arrangements and operations which present a combination of great skill and sagacity, with that good fortune which all great commanders appear to share in common, the reinforcements were brought safely into Sir C. Napier's camp on the 22d.

On the morning of the 24th, with 5,000 men and nineteen guns, he marched against Shere Mahomed, who was strongly entrenched at Dubba with 25,000 men, defeated him with the loss of 5,000 men, seventeen standards, and fifteen guns, and completely dispersed his army.

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The British loss was 270, of which number 147 were of the 22nd regiment alone, thus shewing, even in this favourable instance where the 22nd were unusually well-supported by the Sepoy battalions, how immense is the proportion of the fighting and the loss which Europeans always have to sustain when joined with Eastern troops.

This also was a wonderful battle. The ease with which it was won, and the disproportionate loss between the victors and vanquished, furnish the highest testimony to the skill of the General. But for that skill the loss of his troops would have been far greater; and if the slaughter of the Beloochees had been less, and their defeat less crushing, the war would have been prolonged, and a greatly increased loss of life would have been the result.

Sir C. Napier's opinion was, that the best method to save bloodshed for a soldier is to be master of his profession.

"How else," he said, "could I command with honour? How answer for the lives of those entrusted to my charge? An ignorant general is a murderer: all brave men confide in the knowledge he pretends to possess, and when the death trial comes their generous blood flows in vain! Merciful God! how can an ignorant man charge himself with so much blood? I have studied war long, earnestly, and deeply, yet tremble at my own deficiencies."

After the battle, the Ameer, with the discouraged remnant of his army, had retired on Meerpore, Sir C. Napier, one of the commanders who thought nothing was done so long as anything remained to do, prepared to follow up his stroke while the effect of the battle was fresh.

The troops had fought for three hours in the battle, with the thermometer at 110° in the shade. Their General gave them but eight hours' rest, and marched on Meerpore. His wisdom in pressing on was proved by the fact, that the troops in this march passed through two strongly entrenched positions which the Lion had prepared, and had intended to dispute, but which, in the panic immediately succeeding the action, he could not get sufficient men to defend. This, however, would not have been the case a few days later.

The day after the battle Sir C. Napier's cavalry was at the gates of Meerpore, forty miles from the field. The consequence of this vigour was that Shere Mahomed abandoned his capital, and fled with his family and treasure to Omercote.

Even while taking possession of Meerpore the General sent the Scinde horse, a camel battery, and a regiment of infantry in pursuit of the flying Ameer, who, thus pressed, abandoned Omercote as he had done Meerpore; and Omercote, the desert fortress, Shere Mahomed's last resource, 60 miles from the edge of the desert and 100 from the field of Dubba, opened its gates and was garrisoned by a British detachment just ten days after the battle. Shere Mahomed now became a wanderer over the face of the country, with few followers and without a resting place.

Meerpore and Omercote were both strong places, well armed and provisioned, and, if defended by a resolute enemy, might have detained the General in the field far into the hot season; thus enabling Shere Mahomed to gather a new force and to prolong the war.

The army had marched from its camp on the Indus to attack Shere

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Mahomed on the 24th March. On the 8th of April it was back at Hydrabad, and Sir C. Napier slept in the palace of the Ameers, master of Scinde, having in sixteen days defeated 25,000 enemies in battle, captured two fortified places, and marched 200 miles under a Scindian sun.

Shere Mahomed however was still at large, and to complete the tranquillity of Scinde it was necessary to capture him. For this purpose Sir C. Napier again took the field towards the end of May, when the mercury stood at 130° in the tents. The Ameer had in the interval collected about 10,000 men; and the General drew a circle of troops round him to prevent his escape. On the 14th June Shere Mahomed made a dash at the weakest part of the circle, was beaten, and his force utterly dispersed by Major Jacob. The General heard the cannonade, knew that Jacob must be engaged, and feared he might be overwhelmed. On the 15th, while still in anxious suspense as to the result, he was struck down by sun-stroke at the same time with several other Europeans; he alone of all who were thus attacked was left alive at the end of three hours. He attributed his own recovery on this occasion partly to the reviving effect of the news of Jacob's victory, partly to his remarkable abstinence in eating and drinking.

Scinde was now conquered. "We have taught the Beloochee," said the General, "that neither his sun, nor his desert, nor his jungles, nor his nullahs, can stop us, and he will never face us more."

Most of the great feudal chieftains came in and took the oath of fidelity to the British Governor, and what is more they kept it. And the just and beneficent rule of Sir C. Napier conciliated to such a degree the respect and attachment of these wild warriors, on whom he had laid so heavy a hand, that long afterwards, when he was leaving India for the last time, at enmity with the East Indian Government, and when they had no longer anything to hope or fear from his favour or his anger, the Belooch Sirdars flocked in hundreds to pay their respects to him at Hydrabad, and asked leave to present him with a sword of honour. That sword is now an heirloom in his family.

The scene on this occasion has been described to me by an eye-witness, as having been as affecting as it was remarkable. All the avenues into Hydrabad were crowded by the great Belooch Chieftans and Sirdars of Scinde, the shaggy mountain ponies on which many of them rode shewing they had come from the distant hills. Many of them led their sons by the hand, entreating Sir C. Napier that he would lay his conquering hand on their young heads, in the belief that his touch would confer fortune and blessing.

Surely in the face of a fact like this, all detraction of his policy and humanity as an administrator—no less than of his skill and energy as a soldier—must be altogether vain. His was essentially the glove of velvet covering the hand of iron; and his touch was so light, that its force, exerted with crushing effect on evil-doers, was to the well-disposed and the loyal known only from memory or from its action upon the robber and the oppressor.

In reviewing the operations of which I have been able to give only a very imperfect summary, the first thought that suggests itself is the marvellous activity and endurance, both of mind and body, of the English General. During operations in the field, though in the saddle all day, he alone of all his force was habitually debarred from rest at night, and compelled to devote the hours nature has designed for the restoration of the exhausted body

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to wearisome correspondence, of which the vindication of his fame from calumnious attack formed no small portion.

I do not believe either ancient or modern history furnishes a parallel instance of a man being called on for the first time in his life at the advanced age of sixty-two to command an army in the field under circumstances of so much complication and responsibility.

Thrown suddenly in the midst of the, to him, altogether novel field of Eastern intrigue, he yet unravelled all its threads with far more than the skill and tact of the oldest Indian diplomatist; and while his political *attaché*, a man who had been bred to the business, was so blinded and cajoled by the Ameers that he incessantly urged the General to take no offensive measures, thus throwing upon him an awful responsibility which few men would have been bold enough to face, — Sir C. Napier alone among his army, clearly perceiving the danger, disregarded the responsibility, and out of the "nettle danger" plucked "the flower safety," by attacking and defeating a force fifteen times his strength.

If it is seldom that we see consummate prudence tempering the ardour and confidence of a youthful general, it is rarer still to find the fire and vigour of youth animating the sagacity of the veteran. Sir C. Napier possessed in the highest degree the combination of these generally opposing qualities.

Sir C. Napier has been censured by self-constituted judges for undertaking important operations with an inadequate force — such, for example, as his march through the desert to Emaum-Ghur, and his attack on the enemy's position at Meanee. No man knew better than he the danger of despising an enemy, or the propriety of bringing to the decisive point every man, horse, and gun, that could by any possible foresight and combination be arrayed there. But in the course he actually pursued, he was governed by necessity —choice he had none.

There are some countries where the want of supplies and natural obstacles render it impossible to operate with a large force. Notably in Scinde, the scarcity of water at certain seasons, and the want of carriage at all times, formed two of these controlling causes. On account of the first, during the march to Emaum-Ghur, the General was obliged to keep with him only 400 men and to send the rest back.

The enterprise for difficulty would seem in prudence to have demanded 4,000 men; yet if he had taken with him only 1,000, he must have failed for want of water. He supplied the want of numbers by courage, hardihood, and perseverance, trusting to the moral effect of these qualities rather than to his apparent force.

It must be remembered that the British forces in Scinde were a mere handful, and could be outnumbered at any point, by ten times the number of enemies. In such a case, dependence on physical force alone, and a pedantic adherence to rules and maxims, would have only been to prolong the war, thereby encouraging the Ameers by an appearance of timidity, and probably calling to their aid the wild mountain tribes who were only waiting, to use a homely but expressive phrase, to see which way the cat jumped.

Both as regarded the prestige of the British name, and the character of his opponents, the moral was more to be considered than the physical effect.

It is one of Napoleon's sayings, that moral force in war is to physical force as four to one. If this be true in European warfare, where the

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composition and courage of opposing armies is nearly equal, we must decide that in the case under consideration moral force was almost everything.

Although therefore Sir C. Napier occasionally disregarded mere technical rules, and placed himself in situations which to men of less transcendent ability would have been ruin, he did so because he measured correctly the capacity of his adversaries and his own; and that which in another might have been the extreme of rashness, was in him only the fruit of the most deliberate and just calculation.

The sun-stroke and the extreme labour he had endured so seriously affected his health at this time, that the medical men told him he must go to Kurrachee and quit work, or else he must prepare to give up life and work together. He went to Kurrachee; but would by no means consent to give up work. "If I take rest one day," he said, "the work doubles the next."

In October, before he had got over the effect of the sun-stroke, he was attacked by a terrible fever, which swept over the land, and carried off multitudes alike of natives and Europeans. Although the sickness was of a very depressing nature, the clearness of his mind never failed, and he was still emphatically the Governor of Scinde; and when his friends, who thought he was killing himself, urged him to resign and go to England, he answered, "No, not to save a thousand lives. The horses here are wild; but they know my hand; with another, they would start off as he was gathering up the reins."

For some months to come Sir C. Napier's labours were devoted to peaceful objects, to the improvement of the condition of the cultivator by altering the tenure of land, by abolishing slavery, promoting irrigation, &c.; and his memoirs on these and other great administrative reforms, drew from Sir Robert Peel the following remark: "No one," he said, "ever doubted Sir C. Napier's military powers; but in his other character he *does* surprise me. He is possessed of extraordinary talent for civil administration."

His efforts were however much interfered with at this time by descents made on the north-west frontier of Scinde by bands of desperate robbers, who from their numbers formed a small army. A wide desert interposed between their mountain strongholds and the frontiers of Scinde. But in the summer of 1844, having committed in some of their incursions acts of great atrocity, Sir C. Napier resolved to undertake their reduction. For this purpose however it was necessary to cross the desert, to track them to their strongholds, to hem them up in a corner where there should be no escape, and afterwards to transport them bodily to the plains, and compel them to labour instead of robbing for their bread.

At some future time, perhaps, it may be my privilege to describe in this theatre, clearly and in detail, this hill campaign, which was, in my belief, as remarkable and as difficult an operation as was ever undertaken by a military commander. I must now content myself with saying, that after a campaign of fifty-four days, commenced on the 16th January, 1845, he returned, after having completely succeeded in all his objects.

He had crossed the desert, tracked the freebooters, 16,000 men, under their chief Beja Khan, a man of Herculean strength and courage, through mountains which for defiles and hidden caves were like a rabbit warren, and shut them up finally in their famous stronghold of Trukkee with their wives

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and families, where he induced them to surrender with the loss of only a few lives. Thenceforth such was the terror of his name that so long as Sir C. Napier remained Governor of Scinde, life and property were almost as secure as in England.

During this campaign he had to bear with the despondency of his own officers, he alone perhaps among the officers (for the men having less knowledge had more faith) feeling any confidence in the success of an enterprise which to others appeared hopeless.

He had to overcome the enormous difficulties of feeding his force, by organizing supplies from the rear; to circumvent the proverbial hill craft of his mountaineer enemies, the duplicity of his guides, and the uncertain fidelity of his allies. With a master hand, and a master spirit, he converted all these disadvantages to his own favour, thus illustrating a passage in Plutarch's Life of Philopœmen, where he says that great man, "adopting the Cretan customs, and using their artifices and sleights, their stratagems and ambushes against themselves, soon shewed that their devices were like the short-sighted schemes of children when compared with the long reach of an experienced general."

The robber tribes captured were removed to the plains on the frontier, where they became cultivators of the soil, and received land from the government on the tenure of military service against the incursions of their kindred robbers; and the measure has proved in fact to be completely successful.

Sir C. Napier now returned to his works of peace, but they were not long destined to be undisturbed. So early as February 1844 he had predicted that a war with the Sikhs was inevitable. He now, with his remarkable forecast of mind, matured the plans which he foresaw he would be called upon to execute with the army of Scinde as an auxiliary to the principal British force on the Sutlege; and it was during this interval, and in preparation for that contingency, that he organized his famous camel baggage corps.

In June 1845, perceiving that the storm was about to burst, he wrote to the Governor-General begging to be allowed to organize an auxiliary force. But Sir H. Hardinge, who still thought at that time the war might be averted, would not allow of any preparation being made, for fear of alarming the jealousy of the Sikhs, promising however that Sir C. Napier should have six weeks' notice for the organization of his field force before the commencement of hostilities.

The Sikhs however gave no notice, and the news of the battle of Moodkee, fought on the 18th December, was the first intimation he received.

Then indeed he was ordered to assemble at Roree with all possible speed a field force of 15,000 men, 10,000 of whom must come from Bombay, as the resources of Scinde were unequal to this demand.

Sir C. Napier had been forbidden to purchase even a camel in anticipation. Thus, when the sudden order arrived, he had carriage for only 3,000 persons, when carriage for nearly 50,000 was required, that being the gross total represented by an Indian army of 15,000 fighting men; and though the Bombay complement of this force numbered 30,000 and had to be marched, after landing at Kurrachee, nearly 400 miles, yet on the forty-second day after the receipt of the order, the whole force required was concentrated at Roree in a perfect state of equipment and discipline; provided with a siege train of thirty-two pieces with 1,000 rounds a gun; eight field

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batteries; engineer park and provisions for three months; as well as a pontoon train bearing 300 yards of bridge.

Only officers who have been called on to organise a force hastily under circumstances of similar difficulty can at all appreciate such a result.

Sir C. Napier's general plan was to create a diversion by marching on Mooltan.

The details were:—

To form his principal magazines at Ooch, situated at the confluence of the Chenaub with the Sutlege.

To divide his force between Ooch and Bhawulpore; to bridge the river at those places, and to make a concentric movement with those two columns on Shoojuabad, which place must be taken. The siege train to ascend the Chenaub in steamers, protected by the Ooch column, which would move along the left bank of that river.

To provide for retreat in case of necessity, a double bridge head was to be constructed at Ooch, and armed with the steamer guns. The defence of this *tête de pont* to be entrusted to the Bhawulpore levies, on which he could rely, so that he should be free to march on Shoojuabad with his whole force.

Shoojuabad being taken, to form an expense magazine at that place, which would then become his base of supply for the siege of Mooltan.

If he succeeded in taking Mooltan, of which he felt little doubt, as he was in correspondence with parties within the walls, that town would be his pivot for further operations. A powerful diversion would already be effected, which would be certain to relieve the British army on the Sutlege of a great deal of pressure; and the advance which Sir C. Napier then contemplated on Lahore, would draw off the Sikhs altogether from the Sutlege to protect their capital.

The General's plan was to move up the Indus from Roree in two columns, one on each bank, with the steam flotilla between them; to pass his whole force to the right bank at Mittenkoke, where he first expected to meet with resistance, and to crush that town under the concentrated fire of his eighty guns. This, he observed, was rather like "killing a gnat with a sledge-hammer;" but, besides the value of time, he knew what dangerous opponents the Sikhs would be behind stone walls, and his object was to terrify Shoojuabad and Mooltan by the example of the sudden destruction of Mittenkoke.

He had laid his plans for raising the population, which was unfriendly to the Sikhs, as far as Deyrah Gazee: and if he had been permitted to assemble his army as early as he had desired, he would, in all probability, judging from his past successes, have burst on Lahore with 25,000 fighting men long before the battle of Sobraon.

But it was otherwise ordained; for the battle of Ferozeshah had been fought, and the Governor-General suddenly ordered Sir C. Napier to quit his army, and come in person to the head-quarter camp on the Sutlege.

Arrived at the Governor-General's camp on the 3rd March, he found the victory of Sobraon had been won, that a treaty was in progress, and that his projected campaign must remain only a project for ever.

Of the treaty then concluded he altogether disapproved, believing that the only way to avert a second struggle was to annex the Punjaub at once; whereas, he said, "if a puppet king like Duleep Singh was established, the

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battle would have to be fought again, rivers of blood would flow, and the result might be doubtful."

In two years from that time, Mooltan, Ramnuggar, Chillianwallah, and Goojerat, bore testimony to the truth of the prediction.

Sir C. Napier quitted Scinde in January 1848. When he first set foot in that country he found society without the protection of law; slavery was widely spread; murder, especially of women, of almost daily occurrence: robbery universal; the only law was that of the strongest.

When he quitted Scinde he left it without a slave. The turbulent Beloochees whom he had found with sword and matchlock, the licensed robbers and oppressors of the poor, had been compelled by him to shoulder the spade and mattock, and were submissive to a constable's staff.

He had in short found a divided population; misery and servitude on the one hand—on the other, a barbarous tyranny. He left an united regenerated people, rejoicing in a rising civilization, the work of his beneficent genius.

The second Sikh war broke out, and in March 1849, just a year after his return, Sir C. Napier again quitted England for India; his appointment to the supreme military command in that country having been most unwillingly forced on the East India Company, by an unanimity of public feeling rarely witnessed.

And so, at the age of sixty-seven, suffering most painfully from old wounds and labouring under a mortal internal disease, he gave up the honourable and honoured repose he had so hardly earned, quitted his wife and children, and, in the words of the facetious philosopher *Punch*, "he took his two towels and his piece of soap, and his scimitar, and he went away to the ship which was to carry him to the sea."

Arrived in India, he found that Lord Gough had in the interval completely broken the power of the Sikhs, and the war was at an end.

Henceforward he had to perform the ordinary duties of Commander-in-Chief. At the end of a year of hard labour, his public career was suddenly brought to a close by a circumstance which is of sufficient importance to be detailed, since it has been misrepresented to Sir C. Napier's disadvantage.

By a regulation of the Indian Government, Sepoy as well as European regiments were entitled to increased pay when serving beyond the frontier of the British dominions. Under this regulation the troops stationed in the Punjaub received that increased pay up to the period when the Punjaub was annexed. When that country was declared an integral part of the British Eastern Empire, the extra pay was suddenly stopped.

And how was it stopped?

No account was taken of the feelings of human nature in general, which are accustomed to view with decided disrelish any diminution of creature-comforts once enjoyed.

No account was taken of the susceptibilities of the Sepoy soldier in particular, which had already on more than one occasion, within Sir C. Napier's own experience, manifested themselves in open mutiny on this very question of reduction of pay.

The extra pay was simply stopped by a dry official order, without explanation, without reflecting on the danger of tampering with the pay of mercenaries, who, while they were bound by no tie of fidelity *but* their pay, had

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many grounds of estrangement in differing religion, colour, and race; mercenaries too of such power, that once aroused nothing could control them.

Although Sir C. Napier disapproved, as any man of common sense must do, of this "*modus operandi*," he set himself to enforce the order and to repress the mischief he feared would result from it. The discontent, as he foresaw, spread widely.

Two regiments in the Punjaub refused to receive the reduced pay, and an active correspondence was discovered to exist between them and other corps, some of them already in the Punjaub, others under orders to proceed thither.

The 41st Native Infantry at Delhi, 400 miles from the other malcontents, refused to enter the Punjaub without the higher pay; and it was well known that many other regiments were prepared to follow their example. Sir C. Napier by dexterous management checked the disaffection in the 41st, and the regiment marched.

But another regiment, the 66th, just arrived from Lucknow, broke out into open mutiny, and actually attempted to seize Govind-Ghur, one of the great fortresses of the Punjaub, which was in the midst of the most disaffected portion of the Sikh population.

The danger was very menacing, yet by tact and firmness it was averted. The severest punishment which the Government could inflict on a whole regiment was to disband it; but the disaffected felt sure this measure would not be resorted to, as the discharged soldiers must be replaced, according to immemorial usage, by men of the same race and religion, their brothers and cousins. Indeed the Brahmins openly boasted that the Government could get no soldiers if they chose to stop recruiting.

Sir C. Napier however broke through the trammels of Indian routine, disbanded the 66th, and gave its colours and number to a Ghoorkah battalion, which henceforth became the 66th Native Infantry.

By this move he check-mated the mutineers. To have disbanded the regiment as a solitary measure would only have been productive of mischief; the Sepoys felt sure the Government could not go on playing that game; they could not disband a whole army; but when they found Government was prepared to replace them by men of a different race, they trembled to incur the same penalty as the 66th had suffered, and murmuring was at an end. I should here mention that the Ghoorkahs make far better and braver soldiers than the Bengal Sepoys generally.

The Governor-General approved of Sir C. Napier's action of disbanding the 66th, but disapproved of his adoption of the Ghoorkas in their place, the only thing that could give point or efficacy to the measure.

Now comes the point to which I desire particularly to direct attention:

Twelve days before the mutiny of the 66th at Govind-Ghur, a new commissariat regulation of the supreme Government, unimportant in itself, came into operation. This regulation caused the usual allowance made to the Sepoys for purchasing their food to vary with the market prices of the places where they were stationed. It happened that its operation in the Punjaub itself would be to diminish—to a very trifling extent indeed—but still to diminish, the pay of the Sepoy in that province. Sir C. Napier judged that to promulgate and enforce this ordinance, at a time when, as was proved twelve days later by the Govind-Ghur mutiny, very serious dis

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affection existed on account of the reduction of pay already enforced—I say the General judged that to enforce this new ordinance, further reducing pay, would make the smouldering embers of sedition blaze forth, and would be in fact an act of judicial madness.

It was not the amount, for that was trifling; it was the fact that it was a *further reduction*, in the state in which the Sepoys' minds were at the time, that constituted the danger. Sir C. Napier took it on himself —in entire accordance with the opinions of Sir Patrick Grant, Sir Walter Gilbert, and General Hearsay, officers of great Indian experience—to suspend—not to annul, but to suspend—the operation of this as yet unknown measure, until its impolicy could be represented to the supreme Government. The whole sum thus withheld from Government only amounted to a few pounds, although that does not of course affect the principle.

For thus overstepping his legal powers Sir C. Napier was, by the Governor in Council, publicly and offensively reprimanded, the general order conveying the reprimand being signed by a major in the Indian army under his command. He was forbidden ever to exercise his discretion in such matters, or under any circumstances, again; and the Commander-in-Chief immediately tendered his resignation of a post which he could no longer occupy with advantage to the public, or with honour to himself.

Any one who will take the trouble to go into this matter will find that I have simply stated facts, and no ingenuity can pervert them.

I will not trust myself to remark on this treatment—a treatment which Sir C. Napier's position, age, and great services ought to have rendered impossible. I will only say that I cannot conceive the possibility of any impartial mind, endowed with the commonest powers of reasoning, which should investigate all the circumstances connected with this suspension by the General of the regulation referred to, without arriving at the conviction that Sir C. Napier was wholly and absolutely in the right; and I will say further, that an officer in his situation would be unworthy to be trusted with any command who would not act in the same manner in like circumstances.

Sir C. Napier landed in England in March, 1851. In August, 1853, he died, after the most acute sufferings, borne with the utmost fortitude and even cheerfulness.

The following quotation from a memoir drawn up by Colonel Rathborne, an able and experienced Indian officer who had served under Sir C. Napier in the field as well as in the posts of magistrate and collector of Scinde, shews how that great man was considered by his subordinates:—

"It is not merely because I have eaten his salt that I am faithful to Sir Charles Napier's memory and to Sir Charles Napier's cause—I am faithful to it from the knowledge that he was really and truly one of the noblest and most admirable of England's sons, and would, had he lived and had he possessed the power, have been the regenerator of England, and the saviour of our empire in the East. He would have fixed the foundations of that empire on the surest basis, justice to the people, securing the people's love. He would have made India a country to be a help to England in its necessities, instead of a sink to absorb alike its treasures and its men. He would have covered its surface with roads and canals, instead of devoting its

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resources to the maintenance in luxury of the drones who now overspread it."

Posterity will not fail to note that the warrior, who, when feasting and rejoicing were the order of the day, was laid aside and forgotten like a rusted tool, was called from his retirement by the unanimous cry of a nation, as the only man who could save the Indian Empire when supposed to be in utmost peril. It will note well,—that this man who was forgotten at the feast, was the first to be remembered in the fray.

To the judgment of that posterity we may safely leave the heroic character and great actions of Charles James Napier, on the one hand: and on the other, the conduct of the ministers of the day, who failed to do honour to themselves by honouring him.

His deeds have been imperishably recorded by the great writer, whose eloquence in this theme was animated and warmed by the most devoted brotherly affection.

He also has passed away from among us, the last of that noble band of soldier brothers, whose bravery, whose wounds, and romantic mutual affection, were as household words in the camp of the great Peninsular army.

Few episodes in history are so elevating, and at the same time so touching, as the record of the early military life of Charles, George, and William Napier.

I again quote from the speech of Sir Robert Peel, made on the occasion already referred to. Speaking of the critical state of affairs when Sir C. Napier took the command in Scinde, he says:—

"It was most fortunate that at such a crisis, and under such circumstances, the command of the British army was upon those days committed to one of three brothers, who, engrafted upon an ancient stem, graced the brigade to which they belonged, by that perfect nobility which derived its brightest lustre from an unblemished private character, and the highest sense of the purest honour, and whose fame, won by repeated proofs of valour in the field of battle, had made their name conspicuous in the annals of history. They had learned—each of the brothers had learned—the art of war under an illustrious commander. During the whole of his military campaigns—of which one of them was the faithful, the impartial, and the eloquent historian; during the whole of those campaigns the exploits of these three brothers were such as to entitle them to the gratitude of their country. In almost every action in the Peninsula they had given proof of their military skill and valour; but in the actions of Corunna, of Busaco, and Ciudad Rodrigo, and during the operations of the Pyrenees, none of the gallant British officers or men were more prodigal of their blood in the cause of their country, than each of the officers to whom he alluded."

England, whose vines bear such clusters, whose mothers bring forth such sons, will never call in vain for men worthy to uphold her honour abroad or to defend her sacred soil; and, though their names are as yet concealed behind the veil of the future, let us hope and confidently believe, that, when the emergency shall arise, the mantle borne by those noble soldiers, transmitted to them, his most illustrious pupils, by their great master, will be found to have devolved on shoulders worthy to bear it.

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There was a remarkable similarity in the characters and dispositions of Charles and William Napier. To say that they had faults is only to admit that they were human. But their most ardent opponents, enemies now no longer, could never accuse them of anything mean or little. Their faults were those of noble and generous natures.

They seem to have adopted from their childhood as their rule of action, the motto "*parcere subjectis et debellare superbos*," and none ever acted up to it more consistently. The readiness with which any story of oppression or wrong was received—sometimes perhaps on insufficient grounds—and the fierceness with which it was denounced; all resulted from a tenderness of nature, which, towards the weak and the helpless, and remarkably towards women, children, and animals, was absolutely womanly.

Ever since his return from active service under Wellington, Sir William Napier's was a life of almost constant suffering, caused principally by a bullet which, having lodged near the backbone, could never be removed.

During the last two years his sufferings were unremitting and intolerable, and I shall ever remember, as one of the most impressive lessons of my life, that I was permitted to witness the fortitude, patience, cheerfulness, and consideration for those about him, with which those sufferings were borne.

None who read the clear and vigorous letters which from time to time, up to a few weeks of his end, appeared in the newspapers, could at all guess the state of torture in which the writer lay; or could appreciate the sublime victory obtained by the indomitable soul over the weak and suffering body.

To him the British army owes more than to any man who has ever lived—for has he not *immortalized* its achievements?

To his pen the great Duke himself is more indebted for the completeness and permanence of his fame, than he is to his own great deeds.

To him finally—and this would have been his proudest boast—the private soldier owes more than to any other man, for his was the first voice to advocate the right of the private soldier to share individually in the honour, as he has always done in the dangers, of the battle-field; and it is remarkable that this right was first practically admitted and stamped as inalienable by his brother in the despatch of his first victory of Meanee.

To the last Sir William Napier delighted in the society of young men, particularly officers. He was always pleased to impart information and to discuss with them the subjects of the day; and the patience, even deference, with which he listened to their opinions in return, shewed a humbleness of mind, which those perhaps who did not know him intimately would have been slow to attribute to him.

The love and the reverence with which he inspired those who thus came in contact with him, partook of the feelings with which a clansman regarded his chief. For the numerous officers who used to repair to his bedside to hear words of wisdom, clothed, as they involuntarily were, with marvellous force and eloquence, his removal has created a gap that can never be filled. But his words and his memory will live in their hearts, and his name will never be forgotten so long as and wherever the English language shall be read.

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Friday, May 4th, 1860.

Colonel The Hon. JAMES LINDSAY, M.P., in the Chair.

SUBSTANCE OF A LECTURE ON MILITARY TRANSPORT BY SEA AND COLONIAL RELIEFS.

By C. ALEXANDER WOOD, Esq., late one of Her Majesty's Commissioners of Emigration.

IT is proposed to divide the Lecture into the following heads :—

I. The Lecturer's opportunities of acquainting himself with the subject to be discussed.
II. The Importance of an efficient Transport Service in Peace and War.
III. The Relief System, and epecially as regards India.
IV. Evils resulting from a Defective Organization of the Transport Service.
V. The Organization recommended in substitution.
VI. Conclusion.

I.—THE LECTURER'S OPPORTUNITIES OF ACQUIRING A KNOWLEDGE OF THE SUBJECT TO BE DISCUSSED.

1. A connection with the late Lord Hardinge, as his private secretary, during the whole of the time he was Secretary-at-War, under the Government of the Duke of Wellington, enabled the lecturer at an early period to become familiar with many matters relating to the organization and economy of the British army. It was, it will be remembered, in 1830, shortly after the accession of William IV., that Sir Henry Hardinge's Pension Warrant, and other important measures which he brought forward, were promulgated. To assist in their preparation the Secretary-at-War had summoned from Edinburgh, towards the close of 1828, the late Doctor Henry Marshall,* and, as he chiefly worked in the private secretary's room, the Lecturer thus became acquainted with that remarkable man, to whom Lord Hardinge considered much credit was due, for many valuable suggestions affecting the condition of the British soldier. This early connection stimulated an interest, which later associations have increased, in all that concerns the soldier's welfare.

2. As regards shipping, the Lecturer's knowledge is derived from fourteen years' experience as a Commissioner of Emigration; and, in support of his claim to speak with authority on the transport of human beings by

* Afterwards employed with Sir Alexander Tulloch in the Army Statistical Department. Author of the "Miscellany," "Marshall on Malingering," &c.

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sea, he will cite a passage from his pamphlet,* published in March, 1859, on the same subject as the present lecture:—

"During a period of ten years—commencing with that of the Irish famine and ending with 1856, when the Emigration Commission was reduced—this Board, besides superintending the spontaneous emigration from the United Kingdom, amounting to nearly three millions of souls (2,798,163), collected by its agency, and contracted for shipping off to distant colonies, no less than 250,000 souls, including, in addition to Europeans from the United Kingdom, negroes and coolies conveyed from Africa and India, to and from the West Indies.

"These arrangements—involving nearly a thousand contracts of affreightment, besides agreements for depôts, &c.—the Board accomplished without a single case of litigation, with very slight mortality, *and the loss at sea of only one ship attended with any loss of life.* ('Guiding Star,' 1,475 tons, a new ship, not heard of after leaving the Mersey, Jan. 1855, on her first voyage.)"

He trusts that he need not say more to convince his audience that he is familiar with the subject which they have met to consider; and, as his object is to mitigate the hardships of brave men, and to afford them more frequent opportunities of enjoying Home Service, he feels sure that he will meet with sympathy and a patient hearing.

II.—The Importance of an Efficient Transport Service in Peace and War.

1. The diagram† exhibits, marked in red, all military stations scattered through Europe, Asia, Africa, America, and over the continent and dependencies of New Holland. For these, periodical Reliefs—involving extensive shipping arrangements—have to be provided. With respect to the division of Home and Foreign Service, it is understood to be regulated in the proportion of one-third Home to two-thirds of Foreign Service. It is believed, however, that, under the present organization and system of Reliefs, the infantry of the line does not enjoy its one-third of Home Service, and the hope is entertained that, by a plan of chartering transports—which will presently be explained—foreign service may be shortened and quicker Reliefs effected for the Army abroad, without any additional cost for transport—and with a great gain of health, efficiency, and attractiveness.

As illustrative of the severity of the present system, the following particulars regarding a few regiments now stationed abroad may be mentioned. These regiments are known to the lecturer, but, for obvious reasons, he will not specify them. One, in 30 years, has been 24 abroad and 6 at home; another, in 26 years, 20 abroad and 6 at home; a third, in 38 years, 33 abroad and 5 at home; a fourth, in 40 years, 34 abroad and 6 at home; and a fifth, in 33 years, has served 26 abroad and only 7 at home. This last instance is rendered all the more remarkable by the honorary distinctions borne on the colours and appointments of the

* "On Military Transport by Sea." By C. Alexander Wood, Esq. William Clowes and Sons, 14, Charing Cross, 1859.

† Exhibited in the theatre of the Institution.

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corps, namely—"Egypt," "Talavera," "Busaco," "Fuentes d'Onor," "Ciudad Roderigo," "Badajoz," "Salamanca," "Vittoria, "Nivelle," "Orthes," "Toulouse," "Peninsula," "Alma," "Inkerman," "Sevastopol." There needs, surely, nothing more to show the severity of the service.

The hardships of the Colonial Service admit of being mitigated by improved transport arrangements, but still it is feared not effectually, without a reorganisation of the infantry of the line; for, unless battalions exist to be conveyed, facilities for their conveyance are manifestly useless. If therefore it be desired—which undoubtedly will be the case—to shorten Colonial Service, then it becomes a matter of primary importance that the infantry organization offer no impediment: whether it do so or not will be a difficulty dealt with under the next heading. But to return to transport. On behalf of the Army, the lecturer claims a frugal use of all money appropriated by Parliament for that purpose.

In 1858, a Committee of the House of Commons placed on record the following opinion:

"That steamers should for the future be always made use of, as far as possible, in *urgent* cases; but that, for the transmission of the ordinary Reliefs, the Committee would not recommend the adoption of so costly a mode of transport."*

This opinion was recorded with reference to transport to India. But its soundness and its general application to all ordinary colonial Reliefs cannot be questioned. Hence, with reference to an economical use of the transport vote, now borne on the Navy Estimates, it would seem to be indefensible to employ for ordinary Reliefs an expensive class of steam troop-ships like the "Transit," "Simoom," "Perseverance," "Himalaya," &c. If, however, such ships are kept in commission strictly for navy and not army purposes, then their use for the conveyance of troops cannot be objected to. But in that case this most costly item ought not to be charged to military transport. Later, in developing his plan, the Lecturer will explain how cheap and good shipping may be obtained,—a question of great importance at the present time, on account of the magnitude of the Indian Army. It may be premised that, for some years before the Mutiny, the moveable portion of this army averaged only 27,000 rank and file. It has since been raised to between 70 and 80,000. Now, the casualties of this army, according to one statement, are 10 per cent. per annum; but, according to another and safer estimate, they amount to as much as 12 per cent. annually. That is, supposing these casualties to remain undiminished, the force deemed necessary for the safety of India will have to be renewed nearly every eight years.

Now, adverting to the other heavy demands on our recruiting resources, to the fact that recruits cannot be had except by voluntary enlistment, and also to the recurrence and probable continuance of the Irish exodus, it is very important that there should not be any unnecessary waste of military resources, and that the Indian casualties should be, if possible, diminished. It will presently be shown what an important influence may be exercised in this direction by an efficient transport service. But it is necessary first to consider the next division of the subject.

* Vide P.P. 1858, East India Transport.

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III.—Our Relief System, and especially as regards India.

Reliefs are now effected by periodical drafts, supplied to every ten service companies from two depôt companies, formed into depôt battalions.

The depôt companies comprise all unserviceable men detached from the service companies—invalids and recruits. Those companies connected with battalions in India and thus composed, with a maximum strength, if not improperly exceeded, of 200 recruits and invalids, have each to furnish every summer, according to existing casualties, at least 120 men, suited to an Indian climate, properly trained, and prepared to contend against all difficulties to be overcome, both by sea and land, in joining—often it is feared without even the protection of trustworthy non-commissioned officers—the head-quarters of a corps, distant many thousand miles. Whether this system be one likely to produce satisfactory results is a question for military authority.

The late Commission on the Organization of the Indian Army, in answer to the fifth* question submitted to them, have recommended a continuance of this system, with only the slight modification of reducing to twelve years the period of Indian service.† This, however, is a recommendation which practically, in the present state of the law, could not be carried out; and the period is now reduced to ten years. But Indian service, for most arms, cannot be protracted much over eight, seeing that enlistment is limited to ten, and that nearly two must be consumed in training and on the voyage. If, therefore, the period be not further reduced, all men sent out will have to be brought home, not to do further duty in Europe, but to be discharged,—with a disgust for the service, easily explained by this unduly protracted relegation to a tropical climate.

The effect of the present system has been described by an officer lately returned from filling a high command on the Staff of the Indian Army in the following terms.

He states, "that it is impossible for any one who has not witnessed, as he did, the successive arrivals of undisciplined recruits, to realise the fearful exhaustion which takes place under the present system." He further states, "that he observed a marked contrast between the drafts and entire battalions. That the former invariably arrived disorganised and sickly, while the latter, for the most part, were in good health and discipline."

Without offering on this point—obviously a professional one—any opinion of his own, the Lecturer, nevertheless, thinks it right to draw attention to the valuable "Paper prepared by an Officer of Rank," which

* 5th Question. The best means of providing for the periodical Reliefs of the moveable Army?

† The Commission also recommended the establishment at the Cape of a Convalescent Station. But it is believed, that, for the soldier drooping from a tropical service, native air and home influences alone will be found efficacious; and that his removal to a colony where a coloured population, less civilised than that of India, exists, would prove anything but beneficial. The selection in India for military stations of healthy localities, and the construction there of proper barracks, are useful and necessary measures too obvious to require the support of medical or statistical authority.

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was read here on the 23d of March last, by the gallant officer who presides to-day. At p. 7 of this important paper, now known to emanate from the highest authority, there is an opinion in favour of instituting for Reliefs by drafts, Reliefs by entire battalions. And it should be borne in mind, as an additional argument for this change, that the men would, by this latter arrangement, be always in organised bodies, and available on the high seas for imperial purposes, while for such purposes drafts are valueless.

With regard to the proper period for a Relief, it is observed, also by the same high authority, that, "with the improved means of transport to India, it would be very desirable that every battalion should be relieved when it should be found unfit for active service by sickness or loss in battle; and that every corps should be relieved after *nine* years' service in India." For reasons above assigned, that period would be too long; and, following the principle here recognised, namely, that a corps should be relieved when no longer effective, it is believed that "five years" will be the safer limit for the recurrence of ordinary Reliefs.

In support of this opinion, the lecturer would again cite the authority of the officer before referred to, as lately returned from a command in India. He states, that when there he made particular inquiry as to the duration of Indian service, and he is confident that a close inspection of official returns will support him in the opinion, that, on the average, men do not serve in India *continuously* for more than five years. Some are invalided and go out a second time, and thus regimental records may show men of more than five years' service, but then it is not continuous. Sir Edward Lugard, in his evidence* before the late Commission, mentions the case of the Buffs, kept in India for 19 years, of whom just one man and an officer came home with the colours of those who had accompanied them from England.

By the aid of an esteemed friend, the Lecturer is able to refer to the eminent authority of the late Sir Joseph Banks in favour of short tropical service. In the autobiography† of Mr. Waterton, the naturalist, the following interesting passage occurs. He states, that, referring to "low and swampy countries within the tropics, in general very insalubrious and fatal to European constitutions," Sir Joseph Banks "particularly impressed on his mind," "that you may stay in them for three years or so and not suffer much. After that period, fever, and ague, and probably a liver disease, will attack you, and you will die, at last, worn out, unless you remove in time to a more favoured climate."

This was, as Mr. Waterton describes it, "the admirable advice" of Sir Joseph Banks, and his friend adds "that he followed it with great success in Dutch Guiana for several years, coming home at intervals agreeably to the excellent and necessary advice which he had thus received."

The laws of nature do not vary, and if the late Indian Commission had not been necessarily so long occupied on the fourth‡ question of the inquiry, and could have found time to examine Dr. Balfour, the present able chief of the Army Medical Statistical Department, it is believed that they would

* Page 147.

† "Essays on Natural History," by Charles Waterton, Esq. First Series, p. 41.

‡ 4th Question. The composition of the Army?

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have elicited from that gentleman much valuable information on the effects of a prolonged tropical residence. He would probably have been able to dispel the erroneous impression, conveyed by evidence and returns laid before the Commissioners, that in India the greatest mortality necessarily occurs among new comers. This is believed to be a fallacy, founded on the experience of unhealthy stations and a defective system of Reliefs, and which is now disproved by the fact, established since the Commission sat, that in 21 regiments of 16,688 rank and file sent to India in 1857-8, and not engaged, the mortality during the first year after landing was only 622, or at the rate of $3\frac{7}{10}$ per cent., which is below the average of a series of years.

Some extracts* from the able and interesting reports of Sir Alexander Tulloch and the late Dr. Henry Marshall, relating to the effects of a prolonged residence in the West Indies, Ceylon, and the Mauritius, may be cited to negative this supposition that the greatest mortality would be amongst the newly arrived. The contrary appears to be the rule, with the single exception of deaths caused by epidemics, which do appear to be more numerous among recruits than among old soldiers.

This is explained by the predisposing influence of fear,—fear to take disease, and fear to succumb to it.

But one important circumstance in favour of short Indian service, it is especially the duty of the Lecturer, as a point identified with emigration experience, to bring prominently under review: viz.

If service be reduced to five years, then service in India may be treated as service in the field.

Now the effect of this change would facilitate a decision which is needed, namely, not to send out any more soldiers' families. A soldier could not complain of his being separated from his family once in his life for five years. A ship is never commissioned for less than three years, and no women are allowed on board. But the necessity of the separation arises from the difficulty of sending with safety any large number of young children on a voyage to India, and for obvious reasons soldiers' children, are, as a rule, very young. In the nine ships despatched last year, the number of children under five years of age amounted to 29 per cent., while the general average in our population returns is only 13·10. The whole number of this age in these nine ships amounted to 1,061, and of that number as many as 341, or 32 per cent., died on the passage, but not from any mismanagement. On long voyages mortality amongst very young children is unavoidable. In 1852, in the Emigration Commissioners' Australian ships, the number of children was slightly increased by a relaxation of the rule excluding families with more than three under ten, so as to admit families with four under twelve. This slight alteration caused the per-centage of mortality to rise from 1·95 in 1851 to 4.94 in 1852. The following year, when this result became known, the former office rule was re-established, and the per-centage immediately fell to 1·66 in 1853, and to 1·59 in 1854, the latter low averages being calculated on 41,065 embarkations, while the former high one was only 34,095. With this experience of the emigration service, and a knowledge that during

* Vide Appendix III. p. 161.

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the Mutiny there was very great mortality amongst the soldiers' children collected at Dum-Dum, the alternative seems to be, a short separation or Death. It cannot be doubted which ought to be adopted.

And here the Lecturer must strongly deprecate any attempt to colonise India by means of soldiers' families. If European colonisation in India be possible and desirable, on which subject the Lecturer offers no opinion, let it be done effectively, as in other colonies, by young couples and families unincumbered by young children. But on the score of humanity he protests against any such attempt with soldiers' families, as it must lead to the inevitable destruction of helpless children.

It may also be added, that, if service in India be treated as service in the field, then the force will lose the characteristics of a local corps, which it must inevitably acquire by a protracted service in a tropical climate, without the excitement of war, and with the present exchanging and volunteering.

Lastly, it remains to be shown that five years' service will not cause any additional expense for sea transport. By a plan which will be presently explained, ships may be chartered under one contract for the double voyage, out and home, at an average price of £25 a head.

In his pamphlet before referred to (p. 12) the Lecturer first made known his scheme, and mentioned £30 as the price at which their shipping could be secured. In the month of November last he reduced his estimate to £25.

An official inquiry lately instituted at the Emigration Office has resulted in a report,* which the Lecturer has been permitted to peruse, confirming the correctness of this later opinion; and, in support of Mr. Walcott's conclusions, it may be observed, that his calculations are made on existing prices ruling in a restricted market, and before the consolidation of offices, which, competing in the same business, unduly enhanced the price of all hired transports. Now, the average price during five years—1852–3 to 1856–7—paid under two separate contracts—one out and the other home—by the East India Company, was: outwards £14 10*s.*, homewards £32 8*s.* or, together, £46 18*s.* a head; being £21 18*s.* a head in excess. On a comparison, therefore, of the working of the scheme with the sums already paid, as shown by a return† lately compiled at the India House, the result appears to be as follows :—

The gross cost of sea transport for all the Queen's troops, cavalry and infantry, drafts and invalids, for the five years above mentioned, was . .	£615,032
Or say in round numbers	615,000

At this period the average annual strength of the Queen's forces in India was 28,161, or say in round numbers 28,000. Consequently the average gross annual charge for transport, including regiments, drafts, invalids, &c. was £123,000.

The cost of relieving an army of the same numerical strength upon the proposed plan every five years, at £25 a head for the double voyage, would be as follows:—

* 27th March, 1860, S. Walcott, Esq., to Maj.-General Sir Alexander Tulloch, K.C.B.
† Vide Appendix, p. 160.

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5,600, or one-fifth, outwards, at £12 10*s.* equal . .	£70,000
8,360, or three-fifths of above number, homewards, at £12 10*s.* equal	42,000
Total	£112,000

The number to be conveyed home is arrived at by assuming that, of the army sent out, two-fifths, or eight per cent. annually, would disappear, either by death, purchasing their discharges, or absorption in India. These casualties, it should be observed, are taken at much less than the present rate. It is hoped that by shorter service Indian casualties will be diminished.

On a comparison of the two systems for the same force, a saving on sea transport is shown in favour of the scheme of more than £11,000 annually. But the above comparison is made on the strength before the Mutiny. If made on a force of 80,000, then the result would be as follows:—

If 28,000 men cost £123,000, 80,000 at the same rate would give £351,428, or in round numbers . .		£350,000
Now, the transport for 16,000, or one-fifth of 80,000, outwards, at £12 10*s.* a head, would equal	£200,000	
9,600 (or less two-fifths, or 8 per cent. per annum, of the number sent out) homewards, at £12 10*s.* a head would equal .	120,000	
		320,000
Or an annual saving in round numbers of (per annum for sea transport)		£30,000

Thus it is now established, on official authority, that an Indian Relief may be effected at £25 a head for sea transport, or less than the "levy-money" * of the cheapest description of recruit, and that for this service the East India Company has paid, on the average of a series of years, as much as £46 18*s.* a head.

Mr. Walcott's Report† and the India House Return‡ before referred to are the documents which authoritatively substantiate this statement.

This saving effectually disposes of any fiscal objection as regards the sea transport. Unfortunately, the Lecturer's experience being confined to the sea-board, he cannot give the particulars of the inland part of the operation. On this account it is necessary that he should anticipate the objection, that his plan will cost too much for land transport in India.

If this question, seriously affecting the health and efficiency of the British Army and the lives of soldiers' families, is to be submitted to the calculations of an accountant, and the decision made to depend on his report,

* "Levy-money" per man:—

	£	*s.*	*d.*
Infantry of the Line	31	13	11
Royal Artillery—Field Batteries	50	5	0
Horse Artillery	73	8	9
Royal Engineers	84	2	5

† 27th March, 1860, S. Walcott, Esq., to Maj.-General Sir Alexander Tulloch, K.C.B.

‡ Appendix, p. 160.

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then there may be claimed as a set-off for this land transport objection a credit—

1. Of £100 per man for every diminished casualty.
2. Of the sums to be paid for moving up country the 10,000 rank and file drafts now under orders for India.
3. Of the like sums for moving down country a corresponding number—less deaths and volunteers—of invalids and time-expired men coming home to be discharged.
4. Of the saving of passage money by not sending out soldiers' families; and,

Lastly, of a good round sum by the suppression of depôt battalions.

When that account is made up, it will probably show a sufficient balance in favour of the Lecturer's scheme, and a result as satisfactory to himself as the recent inquiry at the Emigration Office into the accuracy of his statement, that Indian shipping could be engaged at £25 a head for the double voyage.

One objection to the plan may very fairly be urged,—namely, the difficulty of engaging in England to embark on the return passage any given number of men. But to this objection it may be observed, that the ships proceed by the Cape, while the letter of advice goes overland—that communications by telegrams and railways, as they are proceeded with, will facilitate the service,—and that charters may be carefully framed to meet any inordinate loss on men short-shipped in India.

Before proceeding to the next division of the subject, it is necessary to refer once more to the paper prepared by an Officer of Rank, recommending an alteration in the infantry organization. On this point, which, as it regards the possibility of expediting Reliefs, is a material one, the Lecturer offers no opinion of his own: nevertheless he must insist that it is not possible to transport men effectively and economically, unless they are under the control of one authority, and in bodies regularly organized. Without intruding his own opinions on a professional point, he may, perhaps, be permitted to express a doubt whether drafts would ever fulfil these necessary conditions.

He would also draw attention to the forcible arguments in the paper just referred to, and which coming from such high authority must carry great weight in favour of creating additional battalions.

In quitting this subject the only remark that will be added is, that, if in the proper department it should be considered that the regulation one-third Home and two-thirds Foreign Service can be worked most effectively by regiments of three battalions, then it would seem that such regiments as already possess twenty-four companies may be forthwith reorganised and raised to regiments with three effective battalions, without any additional expense to the country.

IV.—Evils resulting from a Defective Organization of the Transport Service.

In the month of March, 1859, the Lecturer published his views on this subject. He remarked that—

"At present there are two public departments doing the same business

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and competing in the same market. Any one acquainted with the business of taking up shipping by public tender knows the advantage of being able sometimes to decline all tenders without the risk of losing a desirable ship by its charter to another public department."

He also observed that—

"Another advantage derivable from a concentration of authority is, that any improvement connected with health, dietary, fittings, or other details which experience may recommend, could at once be adopted by the War Minister, instead of first being subject for discussion between two separate departments, as will probably now occur on any important alteration in the transport service. But to perfect a transport system constant changes will occur, as the experience of several voyages, if carefully watched, suggests improvements; and these, if another department has first to be consulted, may not be so readily adopted.

"The chief benefit, however, expected from such concentration, is the possibility of placing in the same hands the control over the troops to be conveyed, and the ships chartered for their conveyance. At present there is a divided authority between separate departments—the Quartermaster-General's Office and the Admiralty, or, if the troops are destined for India, the new Council. But for the successful movement of bodies of people by sea as well as on land, an undivided authority over the whole operation is indispensable. A divided authority increases uncertainty; and, as every uncertain contingency has to be provided against in the charter, the shipowner is sure to charge for it as a certainty.

"Again, unless the same department which controls the men also engages the ship, and is made liable for her detention if kept waiting for men, or for an alteration of the fittings when too many or too few of a class come forward for embarcation, there is no security that careful previous arrangements will be made; and, when any miscarriage does take place, each department blames the other, and so both escape censure. Moreover, by a concentration of authority, and the military authorities having the entire control over the transports, there would be less risk of troops on the eve of foreign service being harassed unnecessarily and kept under orders to sail longer than is absolutely necessary.

"It is believed that in the general arrangements of the transport service very great improvements have of late years taken place; but, nevertheless, orders and counter-orders, as to both the time and place of embarcation, not unfrequently do occur.

"Now, it is very desirable that men on the eve of long foreign service should not be harassed unnecessarily; and by proper arrangements the time of sailing may generally be known with certainty a month beforehand, when the ship is taken up. But if when the shipping, as at present, is not under military control, men are, from the fear of being too late, refused furloughs, and unable to take leave of their friends, and afterwards are long kept waiting for their ship, they embark discontented; and, as the British Army has to be recruited by voluntary enlistment, everything which tends to make the service unpopular ought, if possible, to be avoided."

To these general views, the result of experience derived from an analogous service, the Lecturer adheres. But they have recently received

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confirmation by the authority of a medical officer, who states that he has made nine voyages in charge of troops. At the time the Lecturer's pamphlet appeared in England, Doctor Kirwan, late Assistant-surgeon of H. M. 18th Light Infantry, wholly unknown to the Lecturer, and, as he has ascertained, now filling a staff situation in India, published at Calcutta, from "journals carefully kept during nine voyages," his views on sea transport. Without subscribing to all Doctor Kirwan's opinions, his suggestions on many details will be found to be very valuable.* To the authority of Doctor Kirwan the Lecturer would confidently refer in confirmation of his published opinions on the evils resulting from the arrangements for the despatch of troops being distributed over so many departments, and he entirely subscribes to this officer's remark, that "sea transport would be conducted more simply, economically, and efficiently, by having the whole business entrusted to one department especially appointed and educated for that purpose."

The foregoing remarks have reference chiefly to transport for ordinary reliefs in time of peace. But for the most part they would equally apply in time of war. During the three years of the Russian war, the transport votes exceeded fifteen millions sterling; and it is notorious, that of this large outlay much was expended unnecessarily. The average cost of sailing vessels—which the Admiralty hired the first year by the month and not by the voyage, was £1 7*s.* 7¼*d.* per ton. The Transport Board the following year knocked down the average price to 15*s.* 10½*d.* per ton; and, as the original mistake was committed of sending men by steamers and horses by sailing vessels, instead of reversing the operation, much of the large outlay in the first year on steamers was thrown away, as without horses the Army could not take the field. The Himalaya did not reach Varna, on her first voyage with horses, until the 12th of June; while this vessel, with the Ripon, Manilla, and Orinoco, had sailed from England with the Guards, and other infantry regiments, in the month of February.

It is the Lecturer's opinion, that in time of war recourse must be had for the most part to the transports of the merchant service; and that by the aid of this service, if properly directed, our military power may be enormously increased. Now, as a class, shipowners are remarkable for their intelligence; and being necessarily exposed to great competition they must, in protection of their own interests, make for themselves the best bargains they can. For the interests of the public, it is essential that any department engaged in chartering ships should be thoroughly acquainted with this description of business; and it may be regretted that at the close of the Russian war the Transport Board was suppressed. But it is believed that the then First Lord was very desious of preserving the experience of the Board; and it is only just to Mr. Giffard of the Admiralty, the late able Secretary, to mention, that great credit is due to him for the pains which he is known to have taken to improve this branch of the service, and to preserve, as a record for future use, much valuable information which the Board had acquired.

* For extracts from this useful and timely publication, vide Appendix IV. p. 164.

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V.—Organization recommended for the Transport Service.

The outline of the plan which the Lecturer would recommend is given at page 24 of his pamphlet. It may here be briefly recapitulated as follows:—

1. To consolidate the transport business under a Royal Commission to be issued by the War Minister.
2. The Commission to consist of the Quartermaster-General, as president, his deputy, and two Civil Commissioners, of whom one may act as secretary.
3. The Civil Commissioners to be responsible for the engagement of shipping, and the appointment of proper officers to survey and despatch vessels.
4. Financial details to be settled by the Treasury with reference to analogous services performed by the Council of India and the Emigration Commission.
5. The Board to employ exclusively vessels hired from the merchant service of a suitable size, so that two would always carry a battalion. As a general rule, ordinary Reliefs to be effected to and from England direct. This mode of relief, which will bring home regiments more frequently, will be found to facilitate the engagement of cheap transport, as there is a home but not an inter-colonial trade; and every cheap troop-ship must carry cargo as well as passengers., and will be chartered most advantageously for the double voyage out and home.

   The reasons for this form of charter will be found at pages 11 and 14 of his pamphlet.* As before stated, the sum of £25 may be relied on as the fair average price per head of an Indian Relief; and it is impossible that it can be effected for less by vessels belonging to Government. For the reasons against the employment of ordinary Reliefs by Government transports the Lecturer would refer to a memorandum in the Appendix to his pamphlet.
6. Any steam transports which, against the exigencies of war, it may be thought advisable to retain or to construct afresh on new principles, should be under the exclusive control of the Admiralty. But it is believed that even in war the steam fleet of the merchant service will be found equal if not superior to any transports which on an emergency could be turned out of Government yards.

   It may be observed, that, for the safe and quick passage of troop-ships, they ought not, except under great restrictions as to quantity and stowage, to carry military stores; and that, if transports be hired, such restrictions would generally be found to make it cheaper to send their stores by vessels chartered expressly for this conveyance. Such vessels would

* Vide Extracts, Appendix I. p. 157.

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not be subject to many conditions which are only imposed on ships carrying passengers and not cargo.

For this reason, if it could be so arranged, it would be far better for the troops not to disturb the present arrangements for the conveyance of military stores.

7. The vessels chartered for the conveyance of troops to be despatched from certain despatching ports, so selected as to facilitate the engagement on the most advantageous terms of any shipping that may be available at the time, in the principal ports of the United Kingdom. Three such ports, one in the Mersey, another in the Channel, and a third in Ireland, would suffice.

At these despatching ports, baggage warehouses, and facilities for embarking and disembarking troops without exposure to wet, to be under the control of the Quartermaster-General's local officers.

Without going into unnecessary details, the above is an outline of the scheme which the Lecturer would recommend for the military transport service. In submitting it as the result of the best opinion which he can form upon the subject, he can only repeat the observations which were originally appended to it. They are as follows:

"The main point on which he insists, as essential to the efficiency of any transport system, is to attach to the military authorities the responsibility of moving troops by sea as well as on land.

"At the same time he feels that, to many persons, it may seem hazardous to remove from the Admiralty the superintendence of a service which concerns the lives of troops. And he readily admits one advantage attached to the present system, namely, that the decisions of the Admiralty—the highest naval authority in the realm—carry a weight which, when inevitable accidents do occur, opposes a powerful resistance to the undue pressure of public opinion. For it must be borne in mind that by no human efforts can the perils of the sea be always successfully resisted.

"On the other hand, it is believed that Admiralty regulations, framed carefully, but still somewhat with reference either to long usage or the rules of the Queen's service, do not admit of the engagement of merchant ships on the best terms; and that a separate Board, responsible for its own management, and able to deal promptly with shipowners and their brokers, will obtain far better terms than an office, the operations of which must necessarily be under the control of a superior department. Moreover, as a proof that the sea transport of troops may safely be intrusted to a Board presided over by the Quartermaster-General, and subordinate to the War Minister, and with a marine department composed exclusively of civilians, the lecturer would confidently refer to the operations of the East India Company and the Emigration Commission, which latter department has to deal with undisciplined people, including women and children, far more difficult to manage than disciplined troops; and he is confident that such a transport office as above suggested could be organized with perfect safety and every probability of success."

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Conclusion.

It only remains to recapitulate the principal points of the lecture. They are as follows:—

1. The severity of the Colonial service, as shown by the cited cases.
2. The claim of the Army to a frugal use of all money voted for military transport.
3. The waste in employing for ordinary reliefs steam troop-ships.
4. The exhaustion of recruiting resources by the casualties of the Indian Army.
5. The difficulty of keeping up this force unless its casualties are diminished.
6. The mortality amongst soldiers' families on the voyage to India.
7. Advantages, as regards the health and efficiency of the whole British army, and the preservation of life, by reducing Indian service to "five years" as the maximum.
8. Explanation of the process by which this change of system may be effected, without any additional expense for sea transport.
9. Necessity of additional battalions.
10. The present defective organization of the transport service, and evils resulting therefrom in peace and war.
11. The expediency of organising, in connection with the Quarter-master-General's Department, a transport office, responsible to the War Minister.
12. This office to employ, for ordinary reliefs, transports hired from the merchant service; and, as a general rule, the reliefs to be effected from England direct.

The above brief summary will serve to recall attention to the principal points of the lecture, which it is hoped, considering the importance of the subject, will not be thought of inordinate length.

Without any wish to create unnecessary alarm or undue excitement, but, at the same time, with a very strong conviction of the importance of the subject, and also of the difficulty of accomplishing the extensive changes considered necessary to remedy existing evils, it is submitted that the Lecturer may reasonably entertain a desire that the foregoing remarks should be pressed on the attention of the Imperial Government, the Indian Council, and those influential philanthropists who take soldiers' families under their special care and protection, and whose benevolent exertions will—when the proposed measures are carried into effect—become more than ever valuable.

Lastly, if Her Majesty's Government, convinced—through the instrumentality of this Institution—that a case for inquiry has been made out, should decide upon tendering advice to that effect to the highest authority in the realm, it is humbly conceived that the intense interest and earnest solicitude which the Sovereign is known to entertain for the welfare of Her army, would probably induce Her Majesty graciously to yield a ready assent to a measure calculated to improve its efficiency and social condition.

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Appendix I.

Extracts from the pamphlet,* "Military Transport by Sea," showing the advantage, in working Reliefs, of chartering ships for the double voyage:—

"The cost of a soldier's passage to India in 1855-6, and the early part of 1857 (before the extent of the mutiny became known), was under £10 10*s.* per head, medicines and medical comforts included; and, as the victualling comes to about £7, the actual cost of passage was very little over £3.

"That sea transport to India should be procurable on such low terms is at first inconceivable; it is, however, a fact, and one well worthy of consideration by those who advocate the Overland route, or the employment of steamers belonging either to a subsidized Company or to the trade at large. It admits of the following explanation:—The East India Company have very properly so framed their charters, as to admit on board the ships which they engage for troops the easy shipment, in addition, of ordinary cargo. This is the true principle of getting cheap passenger ships. Some articles of course are prohibited, and all cargo conveyed in ships carrying troops, or ordinary passengers, should be stowed under inspection, both to prevent excess either of quality or quantity, and to secure its proper stowage, especially when iron and like heavy articles are in question.

"The effect of the Company's mode of hiring transports is thus explained by an eminent London broker, consulted by the writer on many details connected with the Transport Service, and to whom he feels much indebted. He says:—'Ships trading to India can get dead weight, such as metals, beer, and heavy Manchester goods, &c.; but cannot get sufficient light measurement goods to fill their lofty and spacious between-decks. It therefore answers to take troops at a small remunerative price, as better than nothing or next to nothing; and it enables them to leave out a portion of the heavy articles which otherwise they would have to take, lightening the ship and enabling her to make a quick instead of a slow passage, and thus to save in wear and tear, wages, and provisions.' The late discoveries in the use of distilled sea-water may further facilitate the carriage of goods in troop ships.

"It is however in the passage to India that the very low freights prevail; and, although the writer does not possess returns showing the average cost of a homeward passage, still he believes it to be more than double that of the passage outwards. It is hoped to remedy this defect by the plan hereafter explained, and to reduce the cost of passage, out and home, below £80, or less than the charge for an infantry recruit; but it may be useful first to quote the opinion of the late Committee relative to the use of the overland route, as a great deal of valuable evidence was taken on that point. It is as follows:—'That, although the overland route may be advantageously employed in times of emergency, it would not be advisable

* Published, March 1859, by William Clowes and Sons, Charing Cross.

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that it should be relied upon as the ordinary route for the transmission of troops to India.' In this view the writer entirely concurs.

"In the Conclusion the writer has given his reasons against Government contracting with a public company to undertake the whole Indian Transport Service—a proposal which has been made; and in a separate memorandum annexed, supplied by the same experienced person before mentioned, to which he would draw particular attention, will be found the arguments in favour of transporting troops by hired rather than Queen's ships. At the same time he admits the advantage of keeping a limited number of steam transports, *to be commissioned if required*, and of occasionally employing the fleet, as in the Russian war, to assist in transporting an army.

"The plan which has occurred to the writer as most likely to reduce the cost of passage, is that of chartering ships for the double voyage, out and home. It has already been explained, that, to obtain cheap sea passages, the ship must carry goods as well as passengers. Now, between this country and all its possessions abroad, there is already a trade; but there is very little intercolonial trade. If, therefore, a transport be chartered for the double voyage, out and home direct, and not to an intermediate colony, the ship both ways will have a chance of ordinary cargo, and on this account, independently of other savings, will be obtainable at a lower price. The effect of the system will be, to send the relieved regiments direct to England, and their return home, consequently, would be much more frequent. Of course this could not apply to regiments located in the same group of colonies, and whose stations it might be desirable to change.

"As regards India, it has already been stated, that the cost of the passage homeward is at least double that of the outward passage, which before the mutiny averaged much less than £15; and it is in the former that a saving is anticipated, from the adoption of the double charter. The broker before mentioned gives his opinion of the plan for India in the following words:—

"'There would be more extended competition.

"'Owners prefer a certainty, to sending their ships to seek homeward freights, which fluctuate very much.

"'They would lay in here the most costly of the provisions on cheaper terms than in India, and always, but more especially in case of a quick run out, save their surplus stores; while the water-casks, cooking apparatus, and other fittings, being already on board, these would materially lessen the expense, as compared with the cost of taking up in India a fresh ship unprovided with these fittings. With proper arrangements, aided by the overland communication for the Reliefs, there would be no difficulty in adjusting the outward and homeward demands for tonnage, and the vessels might be taken up in a similar manner to the Coolie ships chartered by the Emigration Commissioners—namely, to be placed at the disposal of the local government on a given day (say five or six weeks after the date of arrival), fitted, provisioned, and ready for the reception of troops, their dead-weight of cargo being previously on board and stowed away.'

"The only difficulty which attends the double charter, is insuring the relieved regiments being free to be brought away, and avoiding the

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liability to pay for men who may not be carried. But the overland communication materially helps the arrangement, and this detail could be provided for in a charter carefully framed, with only a moderate loss to Government when troops intended to be relieved cannot be spared for embarcation by the local authorities."

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APPENDIX II.

RETURN showing the EXPENSE incurred on account of TROOPS and INVALIDS of HER MAJESTY'S and COMPANY'S SERVICES proceeding to and returning from INDIA from 1852-53 to 1856-57.

	TROOPS OF HER MAJESTY'S SERVICE OUTWARD.									RECRUITS OF COMPANY'S SERVICE OUTWARD.				TROOPS OF HER MAJESTY'S SERVICE HOMEWARD.				INVALIDS HOMEWARD.							
	Regiments.				Drafts.				TOTAL.										Her Majesty's Service.				Company's.			
	No.	£	s.	d.	No.	£	s.	d.	£	s.	d.	No.	£	s.	d.	No.	£	s.	d.	No.	£	s.	d.	No.	£	s.	d.
1852-53	—	—	—		2,194	26,198	15	9	26,198	15	9	1,167	15,943	16	3	95	2,027	14	0	1,059	22,308	7	0	175	3,860	15	0
1853-54	3,266	57,081	13	6	2,011	35,147	9	3	92,229	2	9	2,822	46,067	19	3	581	14,510	1	0	1,449	37,427	16	0	174	3,925	0	0
1854-55	1,783	33,014	19	5	1,204	22,293	19	4	55,308	18	9	1,863	29,030	10	3	3,314	113,808	14	0	979	29,974	11	0	257	9,503	0	0
1855-56 *	310	3,786	15	2	1,552	18,958	0	10	22,744	16	0	1,350	15,190	18	0	3,037	116,709	12	9	847	33,690	9	9	126	8,949	10	0
1856-57	1,447	13,489	8	8	1,025	9,555	1	1	23,044	9	9	1,661	17,481	17	6	105	2,896	10	0	766	22,153	1	9	247	6,296	0	6
	6,806	107,372	16	9	7,986	112,153	6	3	219,526	3	0	8,863	123,715	1	3	7,132	249,952	11	9	5,100	145,554	5	6	979	32,524	5	6
Cost per head . .	£15	15s.	6d.		£14	0s.	11d.		£14	16s.	10d.	£13	19s.	2d.		£35	0s.	11d.		£28	10s.	10d.		£33	4s.	5d.	

* Part of a Regiment.

NOTE.—The Totals and "Cost per Head" have been added to the India Office Return.

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Appendix III.

Extracts from Reports of Sir A. Tulloch and Doctor Henry Marshall, on Military Statistics.

West Indies.

Combining then all the information we have been able to collect on the subject, in regard to both the West India commands, we are led to the following conclusions:—

1. That troops are likely to gain but little immunity from either disease or mortality by a prolonged residence in the West Indies.

2. That soldiers are not in general liable to any greater mortality during their first year of service than at any subsequent period.

3. That when circumstances attending the mortality in several corps, during their first year of residence in Jamaica, are minutely investigated, the facts apparently at variance with the above conclusions are sufficiently explained by the occurrence of *four epidemics*, from 1819 to 1827, so that no corps could arrive without encountering their fatal effects within the first year or two of its residence there.

4. That, though in years of ordinary mortality corps long resident in the island suffer as much or even more than those recently arrived, yet during the ravages of *epidemics* there appears a partial exemption in favour of the former.

This peculiarity may, however, be easily accounted for, without attributing it to so indefinite a cause, or one so little supported by numerical results, as the supposed influence of "*acclimatization.*" All the medical reports concur in stating how much the susceptibility to fever is increased by fear and despondency, and these passions we may easily conceive operate much more powerfully on the minds of men newly arrived in the country than upon those who have encountered and survived similar epidemics before. We may easily imagine what may be the feelings of a recruit when he sees the fourth part of his comrades swept off in the space of a month, as was the case in some corps soon after their arrival. We can suppose the apprehension with which he will contemplate the probability of a similar fate, and how little expectation he will entertain of being among the fortunate survivors. He is thus not only rendered more susceptible of the influence of disease, but goes into hospital with scarce a hope of recovery; whereas the soldier who has been long accustomed to the mortality of the country possesses not merely the advantage of being less apprehensive, and consequently less susceptible, but even if seized with fever will keep up his spirits, and contend against the violence of an attack under which the other would sink.

We may mention as a remarkable instance of the influence of *fear* in inducing this disease, as well as of *hope* in repelling it, that, during the epidemic at Up Park Camp amongst the 91st regiment in 1822, when the order was issued for their removal to another station the fever ceased, and though the corps was unexpectedly detained for three or four days after the

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order was issued, not one single case was admitted into hospital in the whole course of that period.

In Jamaica the annual mortality among those resident one year only was 77, and of those two years 87 per thousand, whereas the mortality of those longer in the island averaged 93 per thousand.

Mauritius.

Ages.	Annual ratio of mortality per 1000.		Excess of mortality at each age in Mauritius.
	Mauritius.	Cavalry, U. K.	
18 to 25	20·8	13·9	6·9
25 „ 35	37·5	14·0	23·5
33 „ 40	52·7	17·3	35·4
40 „ 50	86·6	26·7	59·9

The deterioration of constitution with the advance of age in the Mauritius, as shown by these results, must have been extremely rapid. To exhibit its operation in this respect more clearly, we have brought into comparison the progressive increase of mortality at the same ages among the Dragoon Guards and Dragoons serving in the United Kingdom, from which it appears, that, though between the ages of 18 and 25 the ratio is not 7 per thousand higher than in this country, that difference increases between the ages of 40 and 50 to nearly 60 per thousand. Consequently residence in this colony seems to affect the oldest at least eight times as much as the youngest class of soldiers,—a very remarkable proportion indeed, even within the tropics.

Whether this rapid deterioration of life is the result of the soldier's own intemperance or of the influence of climate, it seems equally necessary, as a remedial measure, to limit as much as possible the period of his residence in this island.

Ceylon.

	Under 18.	18 to 25	25 to 33	33 to 40	40 to 50
Died annually per 1,000 of mean strength	$28\frac{3}{10}$	24	55	86	120

This exhibits the same remarkable increase of mortality at the more advanced periods of life as has been observed in the West Indies and Mauritius.

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As those who have been longest in the climate are generally to be found amongst the oldest soldiers, it would appear also to follow from these results that the mortality must increase with length of residence in a corresponding proportion; but that this important conclusion may not rest on doubtful evidence, the deaths which have taken place during the first and second year of residence, among all the recruits who joined from 1830 to 1836 inclusive, have been carefully noted . . . . Thus the mortality which was only 44 per 1000 in the first year, increased the second to 48, and among those whose residence exceeded two years to 49 per 1000.

Bengal.

Civil Servants.

	Numbers Alive.	Deaths First Year.	Ratio of Deaths per 1,000 of Living.
1st year of residence . . .	975	19	19·5
2nd ditto	933	22	23·5
3rd ditto	906	18	20·0
4th ditto	874	19	22·0

Here then we have traced the same individuals through four successive years of residence, with the liability to mortality constantly increasing, and, unless we are to suppose that a different law regulates the mortality of Europeans in the tropical climates of the eastern and western hemispheres, we are invariably led to the conclusion already demonstrated from the previous results.

[In the Report of 1838, p. 86, the following remark explains the diminution of deaths among civil servants after the 10th year, which was shown in one return to have occurred.]

Between 10 and 15 years' service is the period when leave of absence is allowed to those who choose to return to Europe for 3 years, which of course must have a material tendency in reducing the mortality of that class.

[In the Report of 1841, p. 50, referring to the danger of drawing general conclusions from a few regiments, the following remark occurs:—]

In such matters conclusions can only be drawn with safety from the experience of a number of corps, extended over a series of years; and nothing is more apt to lead to error than to assume the events which have occurred in one as a criterion for estimating the influence of climate on the whole.

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Appendix IV.

Extract from Notes on "The Dispatch of Troops by Sea."* By Charles J. Kirwan, Esq., late Assistant Surgeon H. M. 13th (Prince Albert's) Light Infantry.

"These notes, which form some portion of the results of journals carefully kept during nine voyages with troops, are submitted with the anxious wish that attention may be drawn towards the manner in which our troops are sent to sea. Nothing but the conviction that an immense amount of destruction of the property of the soldier, and permanent loss of health (not to speak of the temporary discomfort), result from the imperfect fittings of the ships employed, and the defective arrangements made for the government and discipline of the men when on board, would have induced the writer to introduce a production which he is painfully conscious is full of imperfections. But voyage after voyage and year after year the same subjects for regret have forced themselves on his notice—no endeavour to improve the state of matters has become apparent to him—and no one has taken up the pen either to point out existing defects, or to suggest remedies for them.

Transport service administration submitted to revision.

"The subject of the Sea Transport of troops is gaining such daily increased importance, that it demands that the greatest consideration should be bestowed on every point connected with it. The remarks contained in the preceding pages have been principally concerned with throwing out a few somewhat disconnected hints calculated for the improvement of details. In what follows, it is proposed to glance at the present system of the administration of the Transport 'Service,' with a view to the suggestion of some method for its improvement.

Different departments engaged in transport service.

"It appears that there are at present no less than three Departments directly connected with the despatch of troops by sea, the Admiralty, the Quartermaster-General with the Commandant at the port of embarkation, and the Council for India. There are also different schemes of victualling provided for the troops, according as their destination may be India or any of the other possessions abroad.

Different scales of rations for Her Majesty's troops.

"Leaving out of sight the apparent anomaly of having *different scales of rations*, it may be worth while inquiring whether any good purpose is served by having the despatch of troops scattered over so many Departments, and whether it might not be conducted more *simply*, *economically*, and *efficiently* by having the whole business entrusted to *one* Department especially appointed and educated for that purpose.

* Published at Calcutta, 4th May, 1859, and sold by W. Thacker & Co., Newgate-street, London.

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"Under the present arrangement, it will scarcely be denied that *many ships of an inferior class are sent to sea with troops*. The frequency with which accounts appear in the public prints of troop-ships putting back owing to stress of weather, and the equal or even greater frequency with which they are under the necessity of calling at intermediate ports during their voyage, for the purpose of taking in supplies, seem to indicate that they must have been ill found in the matter of spar and cordage, and that by some means or other they have managed to leave port without a sufficient quantity of provisions.

A better system required.

"Without for a single moment thinking to impute the slightest approach to dilatoriness in the discharge of the public business to any one of the Departments concerned, *it cannot cease to be a matter of regret that such things should occur*. Indeed, considering the circumstances under which they must undertake the duty, rather as a matter extraneous to their usual course of business than as a part of regular duty, it is a matter of surprise that the transport service has not been even more unfortunate.

A responsible head necessary for despatch.

"Under the present somewhat complicated system, there is *some difficulty in fixing the Department to which to address any communications on subjects connected with the transport service*, a state of matters which might occasion delays highly prejudicial to the public interest.

An officer with whom to correspond.

"The duties required in the chartering and superintending the fitting up of troop-ships are such as to require a *special* education added to a knowledge of the requirements of troops. It cannot be fairly supposed that the Admiralty can have a very correct knowledge of, or take a very lively interest in, all the requirements of the soldier, and so cannot be expected to make all the necessary arrangements for his accommodation at sea. The East India House,—however able they may formerly have been to superintend the despatch of troops when only a limited number were required, and when all the transport in that direction was seldom more than the quiet relief of a regiment which had completed its period of Indian service,—now, when the greater part of the available force of the British Army is being poured into its late dominions, can scarcely be expected with the limited staff at its disposal to be equal to the emergency. The department of the Quarter-master-General again, while it may be able to decide most judiciously on everything connected with its more especial duties, must feel that it forms a drag of no inconsiderable magnitude upon their efficient performance, to be called on to provide for and superintend all the details of the embarking and disembarking of such a large number of troops, as annually leave and return to the British shores.

Making the transport service a special study causes an immense saving of public money, especially in war time.

"Independently of the vast amount of almost extraneous labour which the transport service entails upon the department,

The safe and expeditious despatch of

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troops by sea is now so important that its close study should be encouraged.

it cannot be expected that, composed as it is of military men, the qualifications to be found in it are of such a description as to give a sufficient guarantee in every case for the discharge of duties which imply some amount of *special education.*

"While it is only proper that all matters affecting the comfort or efficiency of the soldier should be under military surveillance, still it is proper that the management of details should be left to a class of officers *thoroughly acquainted with their nature.*

"It seems also to be a matter urgently demanding consideration that these officers should be so placed in relation to each other, and to the officer charged with the superintendence of the whole matter, that there shall be no risk of inharmonious working, and *no delays originating from one department requiring to wait for another.*

A new branch of the public service proposed.

"Some such considerations as these seem to suggest the necessity of establishing a *new branch of the public service, having for its duties the superintending of all details connected with the embarking and disembarking troops,* to whatever part of the globe they may be about to proceed.

Simplicity.

"The arguments in favour of the establishment of such a department distinct from any of the other public offices of the country, are various and weighty. The whole working of the transport service would be simplified. All the business connected with it would be performed in one office, and under one management, so that errors and abuses would be less likely to creep in than when several departments did an independent share of the duty.

Celerity.

"The celerity with which the business of the department would be conducted forms a powerful argument in favour of its establishment. It is unreasonable to suppose that any matter can be conducted to a successful issue, or without frequent and annoying delays, when there are two independent parties engaged in its performance. Neither of them are willing to consider that the onus of the matter rests with it, and so frequent delays occur from one department requiring to wait for another.

Better security.

"But the principal argument in favour of such a department rests in the additional security which the Government would have, that ships of a proper class were taken up, that they put out to sea in good condition and well found in sea-stores and provisions, and generally that all the conditions of a well-conducted charter-party had been fully carried out."

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Appendix V.

Particulars of Mortality in the Ships conveying Soldiers' Wives and Children to India, of which official accounts have yet been received.

Thirteen ships were originally taken up for the conveyance of 5,410 souls. We have received intelligence of the arrival in India of nine of these ships, which carried 3,747 souls. In these the mortality was 377, equal to 10 per cent. But this mortality was almost exclusively among children under 5 years old. Of adults (that is, all above 12) there died 11 out of 1,820 = ·60 per cent. Of children between 12 and 5 inclusive, 24 out of 866 = 2·77 per cent. making out of all above 4 years of age, 35 out of 2,686 = 1·30 per cent. This is rather less than the whole mortality in Australian emigration (1·32 per cent.), and considering the class of women, the time (nearly four months) occupied by the journey, and the double passage through the tropics, it must be allowed to be very small. But among children under 5 the mortality amounted to 341 out of 1,061 = 32 per cent. The principal diseases were measles and scarlet fever, which broke out in almost every ship shortly after sailing. These diseases were, no doubt, aggravated by the debilitated state of both children and mothers, caused by the unusually stormy weather which prevailed in October and November last, when the ships sailed. It is to be observed, moreover, that the children under 5 years of age in these nine ships amounted to nearly 29 per cent. the average in the population generally being 13·10. This disproportion necessarily assisted the spread of disease and increased the mortality.

Emigration of Soldiers' Families.

Table showing the Numbers who would have Obtained, and those who would have been Refused, Passages if there had been applied to them the Emigration Commissioners' Regulation, which excludes families with more than 2 children under 7, or than 3 under 10 years of age.

Name of Ship.	Eligible People.		Ineligible People.	
	Women.	Children under 12.	Women.	Children under 12.
Monica	223	262	15	63
Vortigern	168	182	7	24
Statesman	152	194	6	23
Taymouth Castle	128	169	8	31
Accrington	225	244	7	30
Clara	114	90	5	21
Cossipore	166	182	8	30
Clifton Belle	207	189	9	33
Dudbrook	132	143	3	10
Lancashire Witch	207	256	12	48
Euxine	201	212	9	35
Emma Colvin	127	125	6	21
Lord Dalhousie	152	191	5	17
Total	2,202	2,439	100	386

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It will be observed that the number of children returned as eligible is greatly more than in a Government emigration ship, owing to the absence of the husbands and of single men or women. The absence of the husbands no doubt threw great additional labour on their wives in cases of sickness.

Memorandum.

Previously to 1852 the rule of the Emigration Commissioners was to exclude from their emigrant ships to Australia, on sanitary grounds, all families which included more than three children under ten years of age; but they were reluctantly induced, in December 1851, by outward pressure, to relax the rule, so far as to admit families with four children under twelve, and, although this relaxation did not come fully into operation before April 1852, the effect of it was to more than double the average mortality of former years. Immediately on the restriction being again imposed, the mortality fell to rather below its former rate. This is shown in the following Table, where the rate of mortality amongst the total number of emigrants *embarked* in 1852 (when the rule was relaxed), is 4·90 per cent., while in the two previous and in the two succeeding years it was much less than half that rate. It may be added, that subsequent improvements (of which the soldiers' families had the full benefit) in the diet of the young children, and in the fitting up of the ships, have now reduced the mortality in the Commissioners' Australian emigrant ships to 1·32 per cent., which is but little more than one-fourth of the mortality in 1852.

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MORTALITY in EMIGRATION conducted by EMIGRATION COMMISSIONERS during the years 1850, 1851, 1852, 1853, and 1854.

YEAR.	EMIGRANTS EMBARKED.				DEATHS.				PER-CENTAGE OF MORTALITY.				INFANTS BORN ON THE VOYAGE.		PER-CENTAGE OF MORTALITY.
	Adults (14 years and upwards)	Children (1 to 14)	Infants	Total	Adults (14 years and upwards)	Children (1 to 14)	Infants	Total	Adults (14 years and upwards)	Children (1 to 14)	Infants	Total	Births	Deaths	
1850	6,044	1,646	213	7,903	62	77	28	167	1·02	4·67	13·14	2·11	102	18	17·64
1851	9,007	2,356	330	11,693	79	99	51	229	·87	4·20	15·45	1·95	158	18	11·39
Year in which proportion of children was increased 1852	22,084	10,694	1,317	34,095	365	977	343	1,685	1·65	9·13	26·04	4·94	731	145	19·83
1853	20,455	6,514	754	27,723	127	241	94	462	·62	3·69	12·46	1·66	452	71	15·70
1854	30,372	9,515	1,178	41,065	150	354	151	655	·49	3·72	12·81	1·59	649	69	10·63

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Evening Meeting.

Monday, May 7th, 1860.

Captain E. G. FISHBOURNE, R.N., C.B., in the Chair.

The Chairman announced that Nine Members had joined the Institution since the 30th April.

Paterson, E. T. L., Capt. 63rd Regt.
Clutterbuck, G. W., Lieut. 63rd Regt.
Crowther, R. M. B., Lieut. 63rd Regt.
Boyd, Jas. P., Lieut. 63rd Regt.
Smyth, Jas. S., Ens. 63rd Regt.
Atkinson, Thos., Ens. 63rd Regt.
Scovell, T., Ens. 63rd Regt.
Leather, Jno. T., Capt. 2 Dorset Art. Volrs.
Clarke, John, Assist. Surg., 95th Regt.

PRESENTS.

LIBRARY.

Books.

Ellis, C. B. E., Lieut. R.A.—Military Notes, written at Secunderabad, India. No. II. Large 8vo. *Presented by the Author.*

Royal Artillery Institution.—Occasional papers of. Vol. I. No. 21. *Presented by the Institution.*

Royal Society of Edinburgh.—Transactions of the Society, Vol. XXII., Part I., for the Sessions 1857-8. 4to. Proceedings of the Society, Session 1858-59. 8vo. *Presented by the Society.*

Royal Society.—Proceedings of. Vol. X. No. 38. *Presented by the Society.*

MUSEUM.

Military.

Model of Captain Grant's Apparatus for Cooking for Troops in the Field. Complete. *Presented by Captain J. Grant, late R.A.*

11 Spears, 10 Spear-heads, 5 Swords, 1 Knife, from the Somali Country. *Presented by Brigadier Coghlan, Bombay Artillery, Aden.*

Naval.

Model of a Malay Boat. *Presented by Brigadier Coghlan, Bombay Artillery, Aden.*

Miscellaneous.

1 Medal for Long Service and Good Conduct.
1 Ditto for Meritorious Service.
Presented by the Lords Commissioners of the Admiralty.

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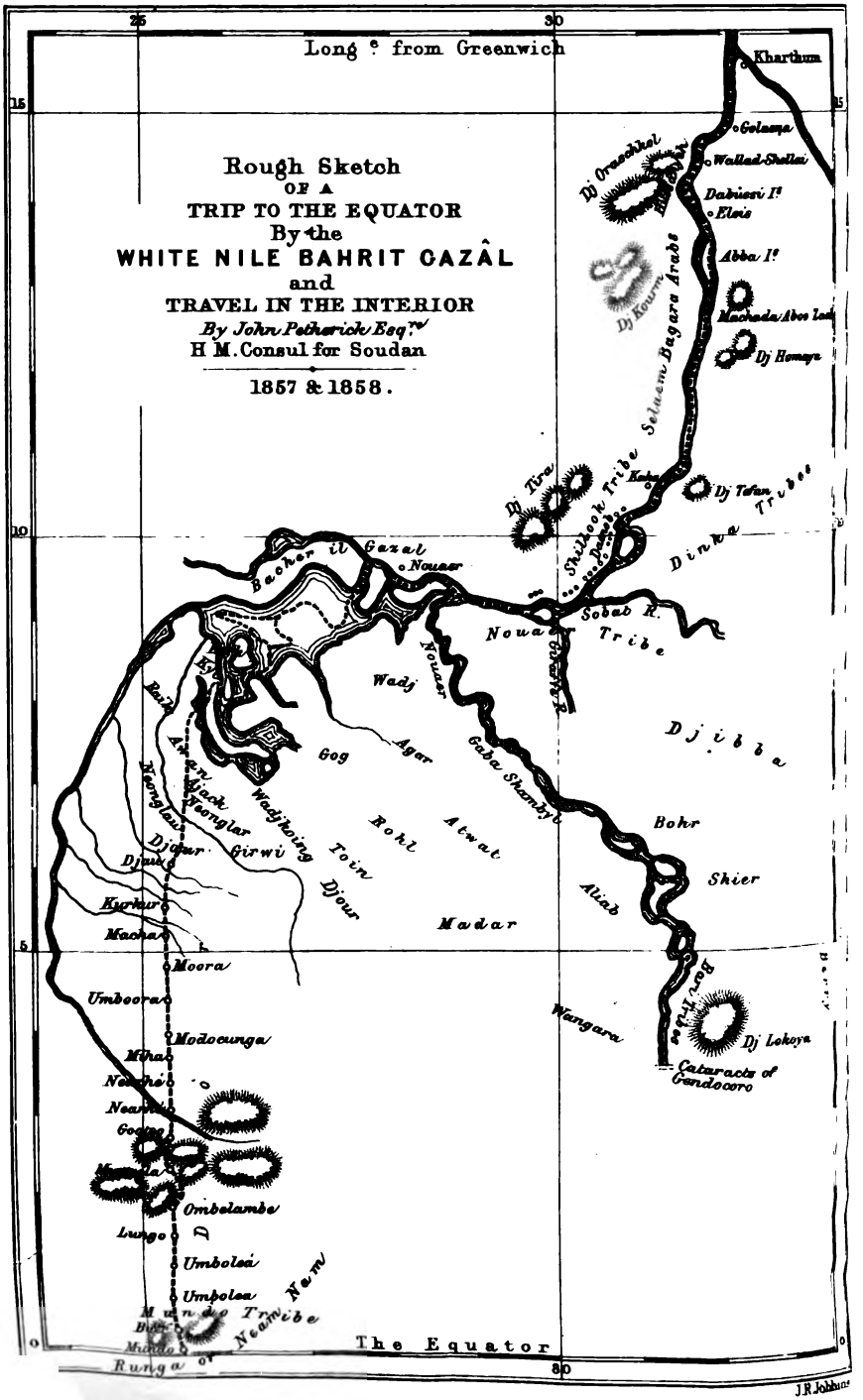

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ON THE ARMS OF THE ARAB AND NEGRO TRIBES OF CENTRAL AFRICA, BORDERING ON THE WHITE NILE.

By JOHN PETHERICK, ESQ., F.R.G.S., H.M. Consul, Soudan.

IN compliance with an invitation from the Council of this Institution, to describe the arms of the tribes inhabiting the countries bordering on the White Nile, amongst whom it has been my lot to reside during the last eleven years, I must beg to solicit, in my behalf, the leniency of the Chairman and Members of this highly learned Society, whom I now have the honour to address, my knowledge of arms and the use of them being entirely unprofessional, and derived less from science than pure practical experience, which, had it not been superior to my descriptive powers, I have little doubt you would have been spared the present communication.

The rich and highly-elaborate Museum of this Institution, containing, as it does, specimens of every description of fire-arm, from the crude match-lock to the most perfect specimens of the rifle of our time; any remark of mine upon the subject will be superfluous, and I shall commence my subject with a description of those tribes who, if the use of powder be not entirely unknown amongst them, object to burn it, and prefer to combat single-handed with cold steel, as did their ancient conquerors the Greeks and Romans.

The Arab tribes, as you are well aware, bordering on the Mediterranean, and far into the interior of Western Africa, have for centuries been familiar with the match and fire lock. Ascending the Nile, the first Arabs, with but few individual exceptions, repudiating the use of fire-arms, are the Jemaes, Ababda, and Bishari tribes, inhabiting the eastern Nile bank, and thence the Desert, to the shore of the Red Sea. The territories of the Jemaes extend from north to south, from Cairo to Keneh, in Upper Egypt; the Ababda, from Keneh to the second Cataract, and following the Nile to the province of Berber, in the Soudan; whilst the Bishari inhabit the interior of the Desert, and the coast of the Red Sea, from the latitude of Wadï Halfa, or the second Nile Cataract, to the province of Taka, in the south-east of the Soudan.

The arms of the above tribes are fewer in number, and, according to their manner of using them, less destructive of life than those used by any other people with whom I am acquainted, and which I can only account for by the repugnance of the Arab generally to slay his enemy, but who would rather wound and disable him, in order that the feud may be confined to himself, rather than descend to generations, as, in cases of loss of life, nothing but blood will expiate it.

A cross-handled, straight, double-edged sword, worn in a leather sheath, suspended by a strap to the left shoulder, and a similar shaped knife or dagger, in a scabbard, attached to the left arm, above the elbow, are the only weapons of the Arabs of the above tribes; whilst for defence a

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thick round shield, from 15 to 18 inches in diameter, made of the hide of the giraffe or antelope, is the invariable accompaniment, which, in the dry climate they inhabit, becomes so hard as to offer sufficient resistance to any blow that may be dealt on it with a sword.

The Arab of either of the tribes to which I am alluding makes use of his sword for cutting only, and then generally at the arms or legs of his enemy, instead of at the head or body, with a desire, as before explained, rather to disable than to kill him, for which reason he never thrusts.

It is only when down or disarmed, and sorely pressed, that he employs the knife, and then, unless he is convinced of the determination of his opponent to take his life, he will invariably strike at the members of the body in preference to any vital part.

The usual method of fighting adopted by these people, when tribe is arrayed against tribe, is on foot, first hiding their cattle in some distant wadi or mountain gorge; but on all marauding excursions, where plunder is the object, they ride fleet dromedaries, for the superior breed of which the Bishari are justly celebrated.

The Nubians, subdivided into Mahass, Kenoos, Dangolauis, Shaygyas, and Jabyeen, since the invasion and subjugation of Nubia and the Soudan by Mahomed Ali Pacha, have adopted the use of fire-arms in the shape of flint-lock muskets and pistols, in preference to the swords and lances of their forefathers; but the nomades of the desert, being less in contact with their conquerors, have retained their primitive arms and mode of warfare.

Thus the Kababish, Meganeen, Hababeen, Hamr, Hauasma, and Bagara Arabs inhabiting the Kordofan and its deserts, in addition to the sword already described, use the spear and lance, but discard the knife, and defend themselves with a long oblong shield of tough antelope hide. These tribes fight on foot and on horseback.

When on foot they mostly confine themselve to the use of a shield, and several lances, which they throw at the enemy from distances amounting to forty or fifty yards.

The horsemen, when going to battle, cover their cattle to the knees with a defensive armour of thick felt, and wear an iron casque and mail shirt over their dress. Their arms are only a sword and spear, which latter, being heavier and of stronger materials than the lance, is but seldom thrown, and then only when certain of effect.

Their mode of warfare consists in a series of brisk charges and as sudden retreats, the fall of a chief, or two or three leading men, being sufficient to decide a battle. The most bloody encounter that I have known during my acquaintance with them, when there have been perhaps 2,000 men engaged, has entailed no greater loss than thirty killed on the field.

They have a wholesome fear of fire-arms, and with two men only, armed with fowling pieces, I have on more than one occasion, whilst travelling in the deserts of Kordofan, kept large bodies of Arabs intent on mischief, at harmless distances.

Following the course of the Nile, and leaving the dependencies of Egypt, the first negro populations are the Shillooks and Dinka tribes, the former to the west, and the latter to the east of the Nile, both of which are large tribes, inhabiting a district extending from the 12th to the 9th degree of north latitude; and the Dinka tribes from the 29th to about the 33rd

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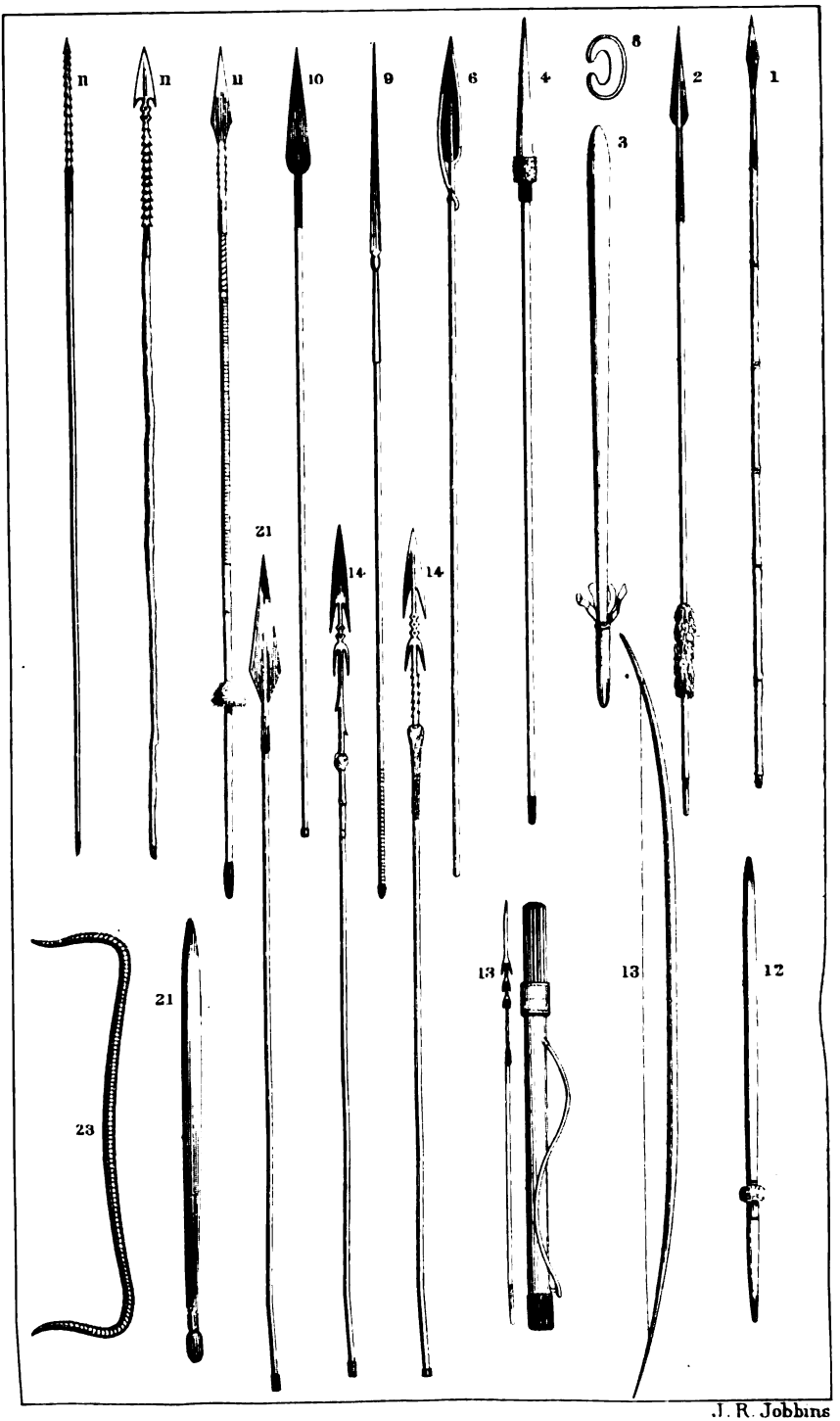

J. R. Jobbins

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degree of east longitude. The Shillooks inhabit a narrower district, perhaps not extending to one degree of longitude, yet are equally as numerous a family; not being so nomade in their habits as the Dinkas, and attending more to agriculture, they live in large villages at but short distances from the river, and, employing canoes, enjoy greater facilities with regard to their intercourse with each other, than is the case with the Dinka purely nomadic race.

The pastoral Dinkas use only one large and two or three smaller lances (see figs. 1, 2), without a shield, a substitute for which is a heavy stick with which they cleverly ward off a coming lance, using it as a club (fig. 3), and with it drive their cattle, of which they possess large herds.

Iron the Dinkas have not, and they are obliged to purchase their lances from their neighbours the Arabs. As a substitute for iron, after insertion in boiling water, they straighten the horns of antelopes and gazelles for lance points (fig. 4).

Their method of fighting, as is the case with the whole of the negro tribes with whom I am acquainted, is on foot, as they have no beast of burthen, and, although they are large cattle owners, the ox has never been made serviceable, as among the neighbouring Bagara Arabs, to carry loads or man.

Leaving the Nile at its junction with the Sobat, and proceeding towards the source of that river, on one of its branches, in about 7 degrees north latitude, and 31 to 32 degrees east longitude, we find the Djibba tribe, a different race, with a distinct language; they are a fine, tall, and well-made people, of dark colour, and ornament themselves with skins of the panther and antelope; the scalps of their enemies, worked up and ornamented with cowrie-shells attached to their own hair, form a tail, which for length and breadth surpasses any thing of the sort worn by the most aristocratic or fashionable member of the celestial empire (fig. 5). Lances (fig. 6) and assayas, their only arms, are particularly sharp, the former often performing the duty of razors. The assaya (fig. 7), intended for throwing as well as cutting, in the same style as a scimitar, by gently drawing it when home, is capable of dealing a fearful wound, its edge being as sharp as hard wood will permit of; and to preserve it from injury, like the lance, it is protected by a stiff leather covering, removable at pleasure (see fig. 7).

The Djibba wears also a peculiarly sharp-edged iron bracelet on each wrist (fig. 8), which, for the double purpose of keeping sharp, and his skin intact, is also covered with a strip of leather, which, however, in case of need, he removes, and closing with his enemy, whom he grasps in his arms, is capable of inflicting serious wounds on him with his bracelets, thus proving the reverse of our custom, that the tighter the embrace the more cutting it becomes.

Returning to the Nile, and following to the furthest point known, the cataracts beyond Gondocoro, about 3½ degrees north latitude, the tribes are similarly armed to the Shillooks (figs. 21), with but slight variation in the shape of the lance, that used by the Barri being much longer in the blade than is usual amongst negroes of other denominations (fig. 9). The Nouaer on both sides of the Nile, from 8 to 10 degrees north latitude, wear a helmet made of cylindrical white beads (fig. 22).

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The people bordering on the Bahr il Gazal, and the interior as far as the 6th degree of north latitude, in addition to the smooth lance (fig. 10), carry two or three barbed lances (figs. 11), which they throw at their enemy while charging, and which, if they penetrate into the body, are difficult to extract, requiring a most severe and painful operation to be performed.

Originally Dinka, and subdivided into many families forming distinct tribes, having their language only in common, these negroes, in addition to a stiff club (fig. 12) made from the root of a tree, which they are expert in casting as well as fencing with, carry an instrument like a bow (fig. 23), for the purpose of warding off projectiles, and which, with the club and a lance, or two, are grasped in the left hand, whilst throwing a lance with the right.

The next tribe to the south extends over 5 degrees of latitude to within 1 degree of the equator, differing in language as well as in habits from any of the tribes hitherto mentioned.

The Dôr, in stature, are not so tall as their northern neighbours, the Dinka and their descendants, being a middle-sized, square-set, and muscular race of people; neither is their skin so jet black, but is of a dark brown or bronzed colour. They manufacture their own weapons from rich iron ores, which exist in what I consider to be the new red sandstone.

The great dissimilarity of the races inhabiting the district from the 6th degree of north latitude to the equator, the limits of my peregrinations, I consider to be caused by the presence of the Tsetse fly, which, by destroying the cattle, necessitates agricultural pursuits, while they in their turn entail fixed residences, though, strange to say, less warlike propensities are not thereby induced.

This tribe, superior to any other known to me in point of territorial possessions and population, recognises no individual chief, but is subdivided into distinct settlements or townships, over which a chief presides, whose sole authority by each separate community is upheld, and which, as a general rule, is at feud with some one or more of its neighbours living at but a few miles apart.

Their only domestic animal is the goat; therefore, for animal food they are obliged to follow the chase; and this often becomes the occasion of quarrels and feuds with their countrymen inhabiting adjoining districts.

Their arms, equally as their habits, differ from the Dinka or the Djour to the north and west of them; the favourite weapon of the Dôr is the bow and arrow (figs. 13), with which they use three or four fearfully barbed spears (figs. 14), and clubs (figs. 15), dissimilar to any hitherto described, and, as is evident from the peculiarity of their shape, are not required to ward off a lance, for which purpose the bow suffices, but are used sometimes to cast, and invariably to inflict a blow wherewith to crush the skull of a fallen enemy.

The workmanship of the arrows will bear inspection (fig. 13), when it will be found that the heads of scarcely two are alike, and the generality of them so numerously barbed that extraction cannot take place without making a considerable incision to free it from the muscle or flesh in which it may be imbedded.

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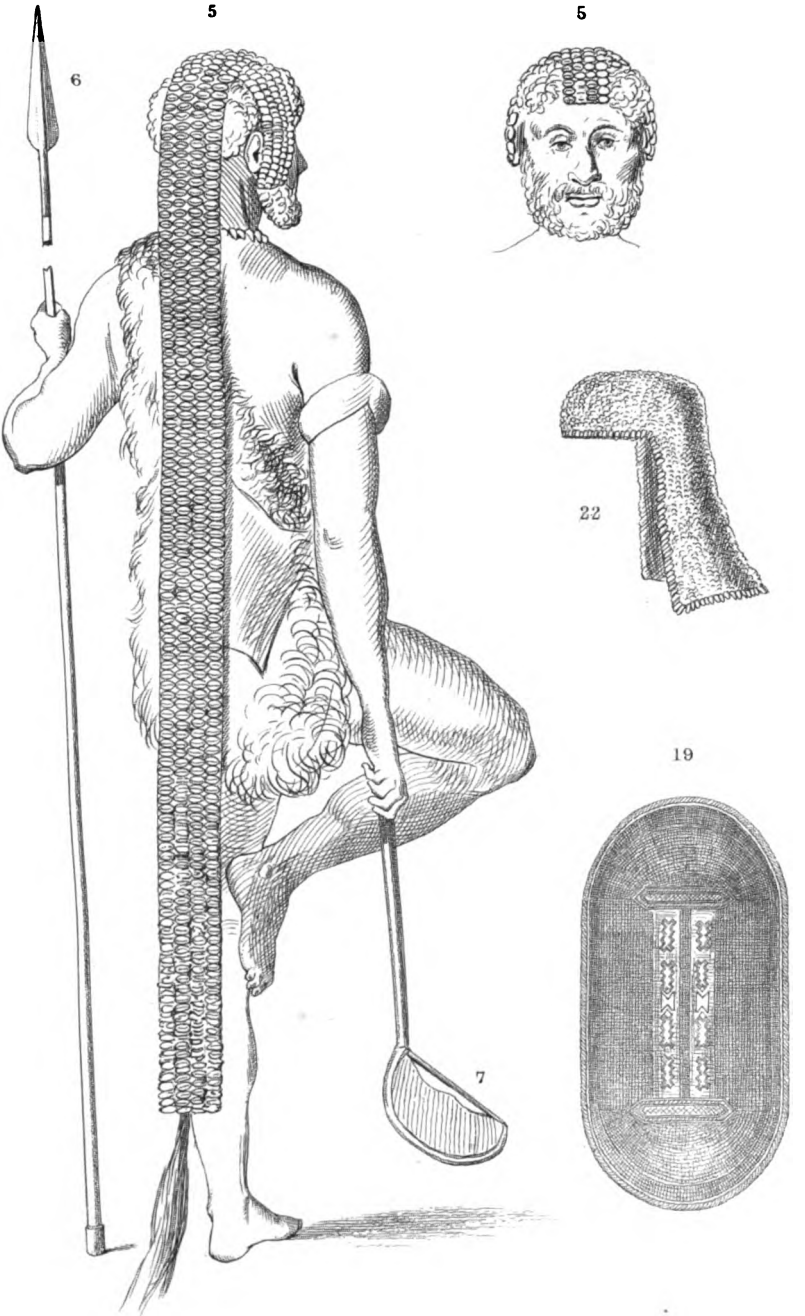

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Occasionally, some of these arrows are poisoned; this, however, with the Dôr is but rarely the case, as they are also used in the chase.

Poisoned arrows are more commonly used by the tribes south of Fazogl, on the confines of the Gallas and Abyssinia, and are less dreaded than might be imagined, as burning out the wound by an immediate application of fire, such as the ignited end of a stick, will invariably counteract the otherwise deadly venom.

The tactics of the Dôr when giving battle are to run up to within fifty or sixty yards of the enemy, and discharge a quantity of arrows at him, and if not successful, to undertake as rapid a retreat; when followed and approached, they receive a similar flight of arrows, which, after endeavouring to evade by a series of gymnastics, as soon as they are spent, they repeat the charge, and so on, until on one side or the other so many arrows have taken effect as to impede the rapid movements of a certain number of the party, which is taken advantage of by a hot pursuit; then, when encumbered by the arrows, the men that have been so hit, unable to extract them and accompany their unscathed companions, drop behind, and thus become the objects at whom to throw barbed lances. If hit by several arrows, or a barbed lance, the unfortunate Dôr, finding no safety in flight, will, like a stag, stand at bay, and endeavour to keep off his pursuers as long as he is provided with an arrow or lance; when, deprived of his own arms, and compelled to stoop to pick up those that have been thrown at him, his relentless enemy, taking advantage of the movement, soon puts him *hors de combat*, by one or more lances in his body; a rush is then made at him, and, if not already down, he is felled by a club, and with the same instrument an end is put to his sufferings.

This sort of running warfare may suit a people with light arms, and unencumbered with clothing; but, having joined a party as a spectator, it was entirely unsuited to myself, attired in a shooting jacket and the paraphernalia of European costume, as, although in tolerable marching condition, the constant running took the wind out of me, and, with only a few men left behind, I was exposed to the charge of the whole body in pursuit. A bold front, and a demonstration of making use of my fire-arms, sufficed to bring the enemy to a full stop and take to a precipitate retreat, which, with little power and less inclination to pursue, and having seen sufficient to satisfy my curiosity, I allowed my friends to take advantage of, from which they returned with four of the heads of the fugitives in their hands, as trophies wherewith to ornament a tree or a pole over the huts of the victors.

Previous to this I had seen the heads and hands of three victims, taken for similar purposes, the bodies of which were secreted in thick bush, to elude discovery and burial by the friends of the slain.

The negroes it will be observed, unlike the Arabs, endeavour to slay as many of their enemies as possible, and have no compunction at destroying life, and so brutal are the particular tribe to which I now allude, that it is a rule with them never to make prisoners, but kill even women and children.

It has been my good fortune, during three years' intimacy with this tribe, to arrest the most atrocious massacres, a recital of which would be more painful than edifying.

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The Mundo tribe inhabit a hilly and even mountainous country between the equator and the first degree of north latitude; and, in preference to the bow and arrow, use the barbed lance (fig. 14), a shield formed of a single narrow piece of hard wood, with a boss in the centre, as a guard to the hand (figs. 16), and an iron projectile not unlike a bill-hook, or curved sword (figs. 17).

Clever in the use of this instrument, the Mundo throws it with considerable address, employing it in the chase for killing antelopes, or even smaller game. If he succeeds in breaking the leg of an antelope, it has but little chance of escape, as the hunter pursues it obstinately, killing it eventually with his lance.

The Runga, or Neam Nam, inhabit the regions of the equator, and thence south, and are a large, powerful, slave-holding tribe, calling themselves cannibals, and reputed to be so by their neighbours.

It was not without difficulty that I succeeded in forming friendly relations with these people, and not until I had killed a vulture, which was hovering over my party, and subsequently an elephant, within the limits of their village, would they listen to overtures of any description, convinced though they were by the great noise and effect of my fire-arms, of which they had previously neither seen nor heard, as they afterwards expressed themselves, that it was in my power to exterminate the whole race.

The Neam Nam make war on their surrounding neighbours for the purpose of kidnapping slaves, to whom they entrust the cultivation of their lands; and, although holding them in perpetual bondage, treat them with consideration and kindness.

The only occupations which a Neam Nam will stoop to, are war and the chase, to which he is from early youth inured, and thus becomes the terror of the neighbouring tribes.

His arms consist of the smooth and barbed lance (figs. 10, 14), and a curiously-contrived projectile (fig. 18), of which I regret to have lost the best samples, with many other curiosities and living animals, by the wreck of my boat in the Nubian cataracts.

The shield is made of reeds, or the leaf of the palm-tree, interwoven in tasteful patterns of variegated colours (fig. 19); and a kind of cloth, with which they cover themselves, is also made by this tribe of the inside fibres of bark, the threads of which are dyed with several colours.

When giving battle, the Neam Nam has two or three of the iron missiles already alluded to (fig. 18), suspended by a leather button to the inside of the shield, lying directly over the handle of it, the whole of which, and a couple of lances, he grasps with his left hand, whilst with a lance in the right hand he assails his enemy. The iron weapon, when employed, is thrown with great force, and in such a manner as to revolve upon its centre when spinning through the air, therefore the wound created by such an instrument must be a fearful one.

The shield made of so light a substance will not repel a lance, but when struck by one, the combatant giving it a slight movement, either to the right or left, counteracts the penetration of the lance, which, becoming entangled and suspended in it, furnishes him with his enemy's weapon, in lieu of his own, which he is supposed to have cast.

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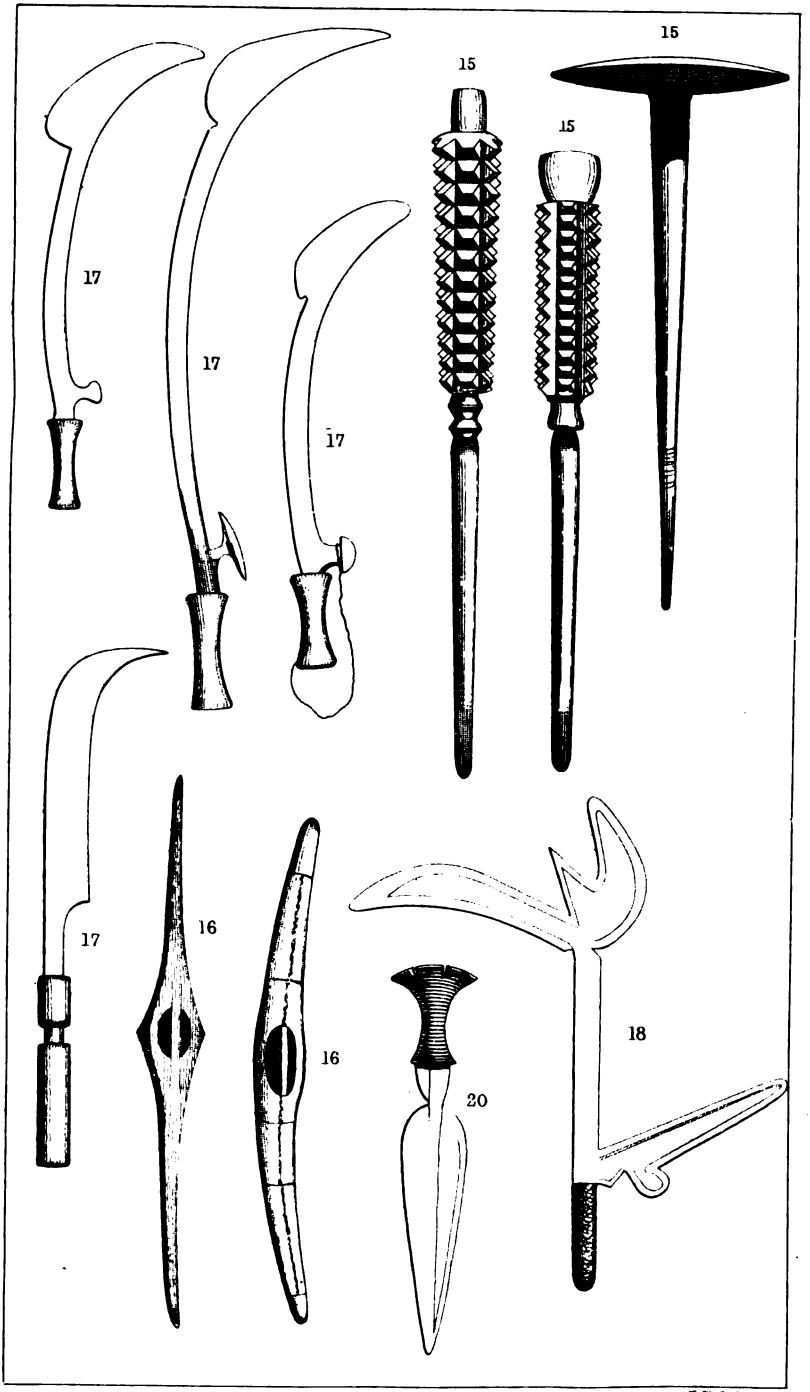

J R Jobbins

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Attached to his waistbelt is a knife (fig. 20) suspended by a ring to the scabbard, hilt downwards, which perhaps is the most convenient way of drawing it, being easily done without requiring the assistance of the left hand, and, fitting tight, undergoes no risk of falling out. The point of the sheath, it will be observed, is turned outwards, so as effectually to prevent its injuring the owner in case of a fall or whilst stooping.

The negroes generally trust less to a shield to ward off a lance or threatened missile than to their great agility in jumping out of its way, at which they are exceedingly clever, and their frequent complaint against fire-arms is, that, not being able to see the ball, they cannot evade it.

With regard to manufactures I may, perhaps, be permitted to state that the Shillooks work a very neat mat of reeds, which, spread on the ground, is doubtless but a modest dining table, but of which they are proud; these mats are of various colours and numerous patterns.

But for the first attempt to manufacture an article of dress of a complicated nature by an independent negro tribe in the regions of the Nile, the merit must be given to the Neam Nam, a specimen of their work, as a relief to the dark side of their character, that of cannibalism and slave-hunting, I am happy to introduce to your notice.

Trifling as the present sample of negro manufacture may appear at first glance, it proves that those races hitherto ignored by the civilized world, and abandoned to their own impulses without the benefit of any moral check or example, are at least possessed of sufficient intellect, and even industry, to give rise to hopes for improvement, both morally as well as spiritually, were they but afforded the opportunities; and I cannot close the subject of the present paper without availing myself of the opportunity which it affords me to express a hope that it may be the humble means of enlisting the sympathies of the Members of the Royal United Service Institution in behalf of the country and tribes which I have had the honour to introduce to their notice.

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Evening Meeting.

Monday, May 16th, 1859.

Colonel P. J. YORKE, F.R.S., in the Chair.

ON A PROPOSED NEW SYSTEM OF FORTIFICATION.*

By JAMES FERGUSSON, Esq.

MR. FERGUSSON. Mr. President, it is now as nearly as possible six years since I had the honour of addressing an assembly in this place upon the subject which I am going to broach this evening; but I am bound to say that I have very little to add to what I then said regarding it. Perhaps it will be considered somewhat conceited in me to say so, but I have seen no reason to alter my views, for, though there is no doubt that great progress has been made in the subject since that time, all that has passed has only tended to confirm me more and more in the correctness of the views I then enunciated. I now in consequence feel so strongly confirmed in them that I cannot but feel that I may be justified in bringing them again before you, more especially at the present time, when everything concerning fortification is of such intense interest that I am sure I need make no apology for so doing.

It was not however my intention to have brought forward the subject again at present, nor till the results of the late war were more completely before the public. Since I last addressed you we have gone through a war of great importance, and principally a war of sieges, and those sieges bear most distinctly and strongly upon the science of fortification, so that I wished, before I again brought the subject forward, to be more fully in possession of the details of those sieges, and when the Committee of this Institution asked me last year to lecture upon my system of Fortification, I declined, because I had not then such information as I thought would give novelty to anything I brought forward. On the present occasion the same reason exists, but the interest felt upon the subject is now so great that I thought it judicious to waive my objection, and to bring forward such information as I possess.

During the great war with Russia, three very important sieges took place. One was at Bomarsund, and that was entirely a siege of a masonry fortress —and that masonry fortress was knocked down in a shorter time than any fortress of the same importance was ever destroyed before. The next siege was at Silistria, where a little earthwork called the "Arab Tabia," resisted longer than any earthwork had ever done before, and eventually beat off

* This Lecture was delivered by Mr. Fergusson on the 16th May, 1859, and was followed by the discussion which is appended to it. It was thought better not to publish it in the Journal in the order of its date, but to reserve it until after the reading of another paper on the same subject, by which it was expected that the discussion would be continued. The second paper and discussion will be found at page 198, *et seq.*

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the enemy. Many persons may state that there were extenuating circumstances; but it is a curious coincidence, at least, that the masonry went down and the earthworks stood. The third siege was Sebastopol. I am aware that there is a great deal to be said on both sides with regard to that great struggle; still what I brought forward here when I last addressed you was, that the only mode by which a place could be fortified was by the use of earth and an abundant supply of guns; that guns and earth were the only means of defence; and that further, the mode in which these elements were used was of the utmost importance. What I then contended for was to have a sufficient power of artillery, and that artillery not propped on masonry. Those were the great principles that came into play at Sebastopol, and the siege was of necessity the most important that has ever taken place since the invention of gunpowder. These, gentlemen, are very important facts, and give me confidence in saying now that I was not much mistaken in the views I before brought forward; but another circumstance besides the events of that war has induced me to come forward, which is this:—recently we have had a complete revolution in firearms, "Brown Bess" has been abandoned, and an improved rifle has been put into the hands of all the soldiers of Europe. Artillery has, within the last twelve months, been entirely revolutionized through the exertions of various ingenious gentlemen, but especially by our countryman Sir William Armstrong; so that in all future wars artillery will be a very different arm to what it has been before.

The old system of fortification was invented during the reign of "Brown Bess," and it was invented for the purposes of the imperfect artillery and the imperfect musketry of former days. Those imperfect arms are now superseded, and I am convinced that the old system of fortification must be abandoned also. I believe that many artillery officers who were inclined to oppose me on former occasions have come round a good deal to my views. I may also state that the works which are now being erected at Portsmouth are earth-works such as I would myself have designed, and that in every respect these works are of a very improved and superior form to anything that has been done before. I believe also that the difference which exists now between me and those who have differed from me formerly is very much less than it was.

I may also add, that, during the ten years which have elapsed since my work on Fortification was published, no one has pointed out where the error was in what I then brought forward. There has been a good deal said about details, and I do not mean to say that there was not more or less truth in many of the objections, but the fact that the great principles which I then proposed have been unrebutted I believe I may say is unquestionable.

We shall hear to-night what further objections can be made.

Let me now try and explain to you as briefly as I can the steps by which the present bastion system came to be adopted, and then, as briefly, the mode in which I believe its defects can be remedied. You will excuse me if I am very elementary in what I am going to say, and if I in fact tell you what you all know better than I do myself.

You will recollect that one of the first modifications of fortification adopted after the invention of gunpowder was substituting a low *caponiere*

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in the bottom of the ditch for the high flanking tower, and this was further concealed by a glacis, which was also invented in the sixteenth century, and served with the ditch to conceal the masonry of the *escarpe*. This done, the next step was further to conceal the *caponiere*—the immense importance of which was immediately appreciated—by a counterguard; and the face of this being flanked by the opposite *caponiere*, by easily traced steps this was gradually worked into the bastion form with its flanks.

The next necessity was to give the garrison a *pied à terre* across the ditch, this was done by a small triangular redan which served as a *tête du pont* to the besieged. This done, it was immediately perceived how important the faces of the bastion might become in flanking the face of what was then called the ravelin, and again how important an office that might perform in flanking the ground in front of the bastion. In fact, it was found that the bastion with the ravelin formed so perfect a system of mutual support and defence that by proper arrangements a place might easily be made impregnable against a *coup de main;* and, as for more than two centuries some of the very first talent in Europe has been devoted to the perfecting of this system, it has come out of their hands one of the most complete and perfect pieces of design that human skill has produced. Were infantry in the habit of shouldering their muskets and cavalry of drawing their sabres and marching up to the edge of the ditch to take the fort by storm, there would be an end of the question, and a siege would be an impossibility; *but*, and the *but* is most important, this never has occurred in past sieges, and is not likely to occur in any future operations, simply because the fort is perfectly organised against such a mode of attack, but is perfectly open to another, by which, without risk or danger to the besieger, the fort must fall into his hands within a certain limited number of days.

I need not explain to this audience that, by the establishment of enfilading and shell batteries, by ricochet and direct fire, the artillery of the fort can certainly be destroyed over the limited space which it is necessary should be attacked, that while this is being done the sap steadily and certainly approaches the edge of the ditch, and, when the besieger gets there the conditions of the fight are—a large besieging army with a powerful untouched artillery opposed to a small dispirited garrison without a serviceable gun, and nothing but a few ruined untenable mounds behind which they can hardly find a shelter even for repose, much less for defence; and the result is inevitable, and always has occurred and always will where the conditions are the same.

But the great question still remains unanswered—Are these conditions inherent in the problem? Is it true, as has been so often stated, that, since the invention of gunpowder, the art of attack must be superior to the art of defence? In fact, is fortification impossible?

My own conviction is that all the conditions of the problem may be altered, that the defence may be made superior to the attack, and that the whole difficulty has arisen from a false system, from pursuing an erroneous path, and neglecting any reference to the first principles of the science.

I will now try to explain to you the mode by which I propose these defects should be remedied.

First then, I conceive that a fortification to be of any value must possess two essential qualities at least—it must be secure against a *coup de main*,

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or an attack *de vive force*, and it must be able to maintain a superiority over the artillery of the attacking party.

I have just attempted to explain to you what an immense amount of superfluous ingenuity has been bestowed on the bastion system to obtain the first object. I call it superfluous, because I believe that a wall, say 30 feet high, if efficiently flanked by a cross fire of artillery and musketery, cannot be escaladed, or in fact cannot be passed over until it is breached or destroyed by some means or other. If 30 feet is not high enough, make it 35 or 40. If 7 guns in each flank are insufficient, put 14 or 30. It is a mere question of expense and of construction. The position of the wall is of no importance provided it surrounds the fort and is equally strong throughout; and I may add, you cannot have too little of it, in the first place because nine-tenths of the expense of modern fortifications consists in their revetments, and, secondly, because the less you have the easier it is watched and the easier defended by a small garrison. In other words, if a front of fortification has 1,000 yards of *escarpe* to defend, and especially if that is broken up into detached portions, it will require twice the number of men to watch and defend it as compared with a front which has only 500 yards to be looked after.

To be of any use, this wall must be preserved till at least the enemy is able to establish breaching batteries at the edge of the ditch, a condition not obtained in any system at present in vogue in Europe. In the French system the face of the bastion can be easily breached by firing down the ditch of the ravelin, and its flanks destroyed by firing along the main ditch. It is true that is not generally done, because they are so utterly contemptible and so easily destroyed from the edge of the ditch that it is not worth while to waste time or the powder and shot to do it from a distance. But, besides this, every one of the *escarpes* can be hit by direct firing over the crest of the glacis. Practically the cordon is seen everywhere, and a very slightly reduced charge will enable a ball to hit sufficiently low to do immense damage; and in fact to bring down the parapet. Now instead of this I propose where wet ditches cannot be obtained to dig so deep that the cordon of the *escarpe*, instead of being 8 or 10 feet above the level of the country, shall be 30 feet *below* it, and, as there is no glacis, the difference is even greater than this, because, to fire over his own sap, the besieger must fire as high as if the glacis were there, so that to hit the cordon the ball must fall say 40 or 45 feet in 200, which is 1 in 5 to 1 in 6, and a ball falling in that angle can do but little injury to a well-built wall, and its aim must be so uncertain that no danger need be apprehended from that cause. But it may be said, if your wall cannot be touched your flanking defences may. If the curve is flat this is not so. The flanking batteries must be placed at such a distance as to be nearly innocuous, but with sharp curves there is no doubt but that a battery at a distance of from 1,500 to 2,000 yards might pitch shot into the ditch which might hit the *caponiere*, the cordon of whose *escarpe* was 30 feet below the country; but is such blind, uncertain fire really to be dreaded? If so, precautions must be taken against it by thicker and better masonry being used; by glacis and counterguards, and other expedients by which the defect might easily be remedied; but still, supposing the *caponiere* very considerably damaged, the besieger cannot avail himself of this fact till he has reached the edge of the

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ditch, till he has established himself there, and till he has got his breaching batteries in order so as to enable him to knock down the untouched *escarpe*.

But supposing, for the sake of argument, that these *caponieres* can be destroyed, as has been asserted, from a distance, the proposition still stands thus, as comparing it with the bastion system,—if a wall whose cordon is 30 feet below the country can be thus breached, how much more easily can a wall similarly placed, but whose cordon is 8 or 10 feet above the plane of site? To say the very least of it, it must be ten times more easy to destroy the flanks of the bastion system than those of that I am proposing, and the destruction of the one opens the place; those on my system are independent, and their destruction only weakens the flanking defence.

This however is by far the easiest part of the problem, and the one regarding which my proposals possess the least novelty; because, beyond burying the masonry deeper than ever was proposed before, I am willing to accept the principle of either the bastion or the Prussian system for this purpose.

The second part of the problem alluded to above is of by far more difficult solution.

It is how to prevent the enemy from getting to the edge of the ditch, or at all events getting his artillery into position there. This, as far as I can see, can only be done by the besieged preserving his artillery in an efficient state throughout. Every siege of modern times has proved that this is impossible on the bastion system. Still I cannot but think that it can be done, and done easily; but, before trying to explain how, let us try and arrive at some general principles on which to base our reasoning.

In Sir John Jones's "Sieges in Spain," it is said that "two or three guns in the prolongation of any face are sufficient to dismount ten, twelve, or any number of guns upon it," and generally it is admitted that one gun in the field is equal to three or four in the fort, and practically in all regular sieges this has been the case. Though generally very inferior in number or in calibre, the guns of the besiegers always are able to overpower those of the besieged. Reasoning *a priori* this ought certainly not to be the case. The first has the command of masonry, and the choice of position; besides, having leisure in time of peace, the engineer ought at least to be able to place himself on an equality with his opponent, and that he has not been able to do so hitherto is a fatal objection to all the systems yet proposed.

In trying to explain whether this objection is insuperable or not, let us assume that two batteries of 10, or any equal number of guns, are erected on a level plain opposite to one another. All things being alike, there is no reason why battery A should not be equal to battery B; but, if battery A has the choice of ground, if it has time to perform its work before hand, and to allow it to consolidate, while battery B is erected in haste under the fire of A, *pro tanto*, A ought to be superior to B. If the place to be fortified is an isthmus of equal width throughout, and which cannot be enfiladed on either flank, 100 guns defending it ought to be equal to the same number, which are all that can be brought to the attack; but if the defenders can choose a wider space, or a spot having some advantage of command or otherwise, their artillery ought always to be able to silence that of the attacking party.

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This however is assuming a peculiar local condition which can rarely occur, though it does occur at Portsmouth, and oftener than would generally be supposed; but, granted that it will not do to design for such a contingency only, it is a fact that circles described with a radius of 5000, 6000, or 7000 yards are practically, as far as defence is concerned, straight lines. The *enceinte* of Paris is for instance, or might be made, practically a straight line; so is the proposed enceinte of Antwerp, and so in fact must all enceintes now be that are intended to defend arsenals or towns from the effect of bombardment with guns throwing shells 9,000 or 10,000 yards. A less radius is absurd, and practically it is immaterial whether we take the circumference or the tangent of such a circle.

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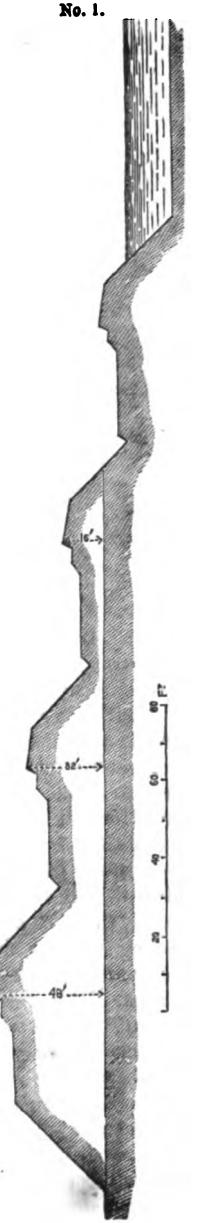

Still there are circumstances in which smaller perimeters must be used; and, if these cannot be, fortified according to this system, it fails. Let us take for instance a radius of 1,200 or 1,500 yards; such a fort could mount from 600 to 700 guns, and, if a train of, say 100 guns, were brought against it, it could easily, without skewing the embrasures, bring a greater number to reply. If the besiegers' train consisted of 200 guns the fort could hardly match it, and if 300 it would be overpowered owing to the large circumference on which the besieger could and would place his guns.

The way I propose to meet this difficulty is by placing two, three, four, or more ramparts of earth one behind the other, as shown in section in the diagram No. 1, and in plan in woodcut No. 2; and by this means even a very small fort may be able to point a greater number of guns at any given spot than the besiegers can from their space point at the fort.

To this arrangement several objections have been raised, which I shall notice presently; but first, the expense cannot be objected to, for, as explained before, if your masonry is to be protected, you must have far deeper ditches than were ever yet proposed; and, if wet ditches are available, (and they are far the best,) they must be far wider and deeper than any yet executed, so that the earth is there, and must be used for some purpose or other, and, to whatever extent it is so used, still these ramparts will never form more than one-fourth or one-fifth of the expense of any system of fortification. In the regular systems of Europe earthwork is about one-tenth of the total cost; and my proposal is, that, in order to get rid of our earth, we should have ramparts arranged in, say four tiers. The first question that naturally occurs is, In what respect is this less advantageous than a rampart in one tier

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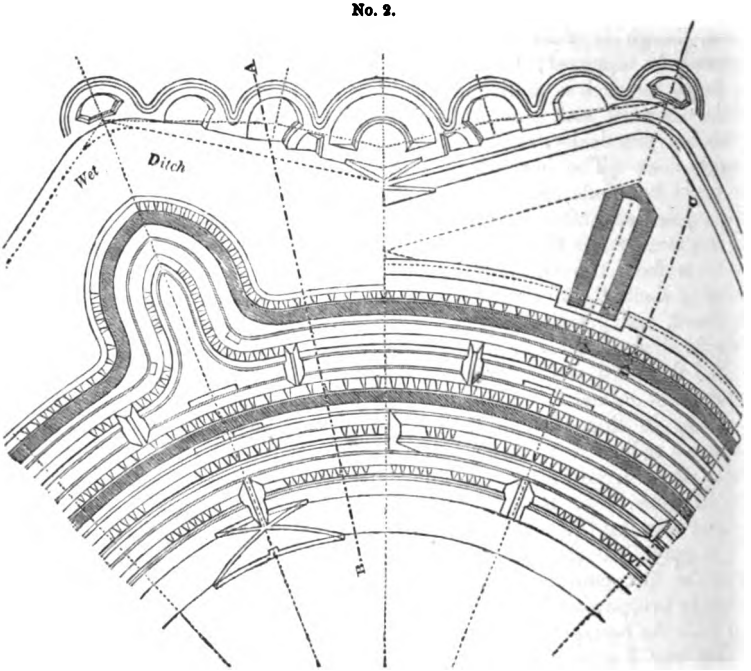

only? If it is found so, arm only one tier, and let that be the fighting rampart; and in the first instance let us assume that it is the upper or near rampart that is so armed.

Todtleben's idea of a perfect rampart is one of earth of the ordinary profile with a very broad berme in front; that berme, he says, catches all the earth knocked away from the rampart above. The workmen can stand in it to replace the earth, and in itself it forms an immense magazine of stuff for the repair of the damaged rampart. With all due deference, I fancy this is a very clumsy way of attaining the desired end. The berme is exposed during the whole siege to the distant shot of the enemy, and after they have reached the edge of the ditch, when its importance is all in all, the workmen dare not venture upon it day or night. Now, supposing we call the rampart in front of the one that is armed a berme, and you have attained all these objects at all stages of the siege, and the rampart in front covers the workmen by day as well as at night, so that in reality the rear rampart can be repaired as fast as it is damaged. Let us next assume, however, that the besieger does pound this rampart to dust, so that it will not stand under any repair, you have only to descend to the next and the next, and renew the combat with fresh guns and fresh embrasures till at last you meet him on the *fausse braie*, which he has never seen, and which is equal in extent to any batteries he can place on the opposite edge of the ditch.

How such a mode of defence is to be met or overcome I do not know.

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I am certain that nothing like it has yet been met in any siege; and I have not heard any suggestion that seems to me to meet the difficulty.

As this mode of fighting the fort suggests one of the objections made to my plans, I may as well mention it at once. It is said that shells fired horizontally, and embedding themselves in the rear rampart, would in bursting render the one in front untenable.

The first answer I could make to this is, that engineers generally do not believe it. Take for instance the new fortifications at Cherbourg. Every bastion there has a rear rampart, placed as I have placed mine; and they are not afraid of the consequences. So too at Paris, and in almost every modern fortification in France and Germany, this feature occurs. Are they all mistaken?

If so, I have erred at least in good company; but, if it is so, I can easily remedy the defect, and they cannot. In the diagram (woodcut No. 3) I have lowered the angle from 45 to 25 degrees, and my belief is that a shot or shell fired from below would glance off and ricochet,—or if it buried itself it must explode upwards, in the line of least resistance, and do no harm to those in front. But if that angle is not low enough it can easily and with advantage be made lower. It is a mere question of £ *s. d.* For every degree you lower it, you must expend so many cubic yards of earth, and if you are prepared to do that, you will gain many advantages. In this woodcut I have also drawn, for the sake of comparison, a section of a rampart of the ordinary construction as applied to the system of Vauban, and, in order to show more clearly wherein the difference between the two systems really lies, I have adopted the same form of revetment for both, though it is one that I by no means think the best that can be used in either case.

It has been said it is no use providing so many embrasures, as it would be impossible to use them altogether,—that the wads and fire from the rear rampart would explode the powder and kill the men in front. All which I admit to be quite true. All I ever ventured to suggest was that you might fire from alternate ramparts, and I still fancy that can be done, but on that point I am quite willing to give way. When guns are covered by Haxo casemates or blinded in any way, it would of course be easy to fire from proximate ramparts, and if the angle of the earth is lowered, as just explained, this would be facilitated very much, and might be carried so far as to render the fighting of alternate ramparts easy; but a cheaper and better plan would be I believe lateral extensions, or, in other words, using a larger radius.

Another objection stated is that blind fire, aimed night or day, will hit the fort, and do damage somewhere. The first of the objections applies to all forts, for that must be a very bad shot indeed which cannot hit a fort; but I maintain that as far as damage is concerned it is much more likely to be done when there are quantities of masonry than where only earth exists, and, as far as blind fire damaging material or killing men is concerned, that is easily provided against. In the first instance, because the lineal feet of parapet provided in this system is so immensely in excess of what can be required that the guns may be spaced 40 or 50 feet apart and a traverse placed between each, besides the great magazine traverses which I propose dispersing everywhere; and, as for the chance of a shot

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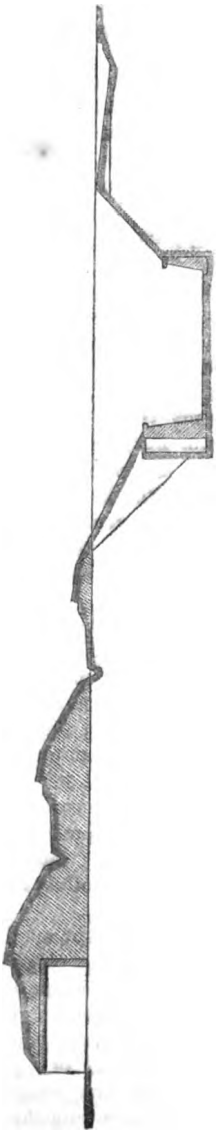
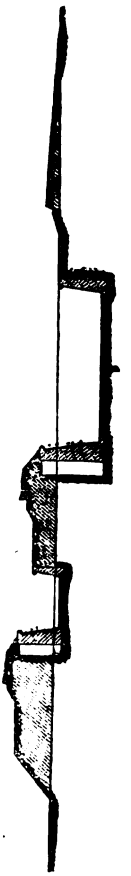
No. 3.



Section of Rampart proposed by Mr. Fergusson.

No. 4.



Section of Rampart with Cavalier Bastion System.

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lobbing along a *terre pleine* and killing a man, it may do so, but a besieger who would spend his ammunition for such a purpose, would, I fancy, very soon tire of his investment.

Another objection I have often heard quoted is, that, once the enemy gets on the lower rampart, he can run up the slopes of the others, and so get into the fort. Perhaps he can, but those that make this objection entirely overlook the difficulty of his getting there. When he is on the *terre pleine* of an ordinary bastion he does not require even that exertion; —the place is his, but all the ingenuity of the engineer is devoted in both systems to prevent his getting there. But would it in fact be so easy? Even supposing the revetment breached, and the successive ramparts damaged, so as to form a breach, nothing is so easy as to cut the ramparts across by traverses or trenches, and to protect them by *chevaux de frise*, and fill these trenches with men firing in flank, and to have cool troops in perfect order prepared to fire on the flank of the disordered column of attack as it passes each of the five *terres pleines;* and who are the troops that could stand such an assault, and that would not be hurled back into the ditch? I do not know of such a feat performed in any modern siege, but it may be done of course.

But can such a rampart as I propose be breached? Let us suppose the besieger to concentrate the fire of 100 shell guns, 100 mortars, and if you like 100 shot guns, on one spot of the rampart,—he can of course pound a space say 20 or 30 yards wide into dust, from front to rear, and render it as smooth as a glacis. But what has he done when he has accomplished that feat? Not one spadeful of earth has fallen into the ditch,—not one spadeful has been carted away. It is all there, and can all be replaced, as soon as his fire ceases, and in the meanwhile he has only temporarily interrupted the communication along the rampart, and destroyed the emplacement of some 20 or 30 guns. But if the curve is sufficiently flat or the ramparts sufficiently numerous, there are plenty to spare on the right or left of the breach, and the mastery still remains with the fort.

But I must not tire you by enumerating objections which can hardly be seriously made, and must conclude this part of my subject by saying why I always prefer circular to rectilinear forms. In the first place, they are cheapest, because a circle incloses a larger space than any other mathematical figure. It is also simple, and consequently more easily handled and adapted to uneven or irregular ground. It is more easily understood, especially by undisciplined troops, and it is the only figure which can be made equally strong in every part. With a polygon as low as a pentagon or hexagon there are dead angles, which are fatal to their equal defencibility, and on each side of the angle the parapet can be cut through, and the reverse of the neighbouring side exposed. With polygons of eight or more sides these objections gradually diminish, and exactly in the ratio to the number of sides, so that a polygon of an infinite number, or in other words a circle, is the most perfect. But practically I do not know one disadvantage that accrues from the use of circular forms, and I know many advantages; and on the other hand many if not most of the disadvantages of the modern systems must be admitted to have arisen from the supposed necessity of using straight-lined forms; but let it be understood I by no means see any objection to their use in revetments if their employment is

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wished for there; but, in the active or offensive part of the defence, I am sure their use is always prejudicial.

In conclusion, in order to understand what I have been saying, you must allow me to reiterate and to impress on you as strongly as I can, that which I conceive to be the real defect of the bastion system,—that it is organised wholly for passive defence, that all its ramparts are designed and all its guns placed to flank ditches or *escarpes* and bits of ground in the immediate vicinity of the fort, to the total neglect of active defence. Now what I propose is to separate these two elements entirely, to make my flanking or passive defence one thing, as simple and efficacious as I can, and, having done this, to prepare in its rear a battle-field for my artillery, so as to enable it to compete on equal or superior terms with the artillery of the attack; and this I believe has been done in the scheme I am laying before you; and, if you will shake off the idea that these ramparts ought to possess flanking or passive powers also, I think you will admit that they will probably answer their purpose.

I can perfectly understand the difficulty any one educated in the principles of the bastion school must have in perceiving this. As before explained, that system is arranged wholly for passive defence; but let me repeat, what I have attempted is to add to that system an active element. I believe I have retained all that is needful of the principles of the bastion system, and in some respects improved on them, and that the new element of a powerful artillery facing the enemy at all times of the seige is a most important addition, which cannot possibly do any harm, but all I think must admit that it may be of use.

My conviction is that it is the most important element of defence. I do not however assert that what I propose is the *only* way in which this end may be attained, or even that it is the *best* way; all I assert is that it is a way, and I ask that it may be admitted to be so till another or a better is suggested.

It only now remains to say one word about the effect which the new inventions in artillery are likely to have on this or any other system of fortification. My own opinion is very distinct. When I wrote my book some ten years ago, it was done with the conviction that the improvements then made in the means of attack had rendered antiquated the usual means of defence. What then seemed an hypothesis, now appears to be a fact. Such a missile as that thrown by Armstrong's gun will certainly cut through any masonry that may be in any degree exposed, and the shells it projects will as certainly cut through any parapet; so that, wherever there is an angle, there the lateral faces can certainly be laid bare and taken in reverse, so that I look upon all angular systems as utterly exploded; and, although the German Trace is far better, and they generally avoid salient angles, and also have sometimes a tolerable perception of the necessity of the separation of the purely defensive from the offensive element, still they almost invariably expose their masonry to such an extent as entirely to neutralize the excellence of their design.

Even if we do not accept Mallet's mortar as a fact, there can be no doubt but that 2-feet shells will be thrown in the next war. My own conviction is that a 3-feet mortar will be accomplished; but, whether or no, any fortress before which even a 24-inch mortar can be placed will certainly

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be irretrievably breached if it depends on a single rampart for its defence, and that rampart stands on the frail prop of a masonry revetment.

Some larger and very different treatment of the subject has now become indispensable, whether in the path I have attempted to point out or in some other remains for you to decide; but one thing I think all must admit as certain, and that is, that fortification cannot now remain where it has been for the last two centuries. Not only is a larger treatment required, but areas must be inclosed which were hitherto undreamed of. A radius, recollect, of five miles—the range of Armstrong's gun—is a circumference of thirty, and that we must take in if we would render our towns free from bombardment. A revolution in warfare is at hand, and that country will have the advantage in the fight that first grasps the new conditions of the problem.

In conclusion, allow me one word, though that word is principally personal to myself.

All I ask of you, gentlemen, is what I asked on a previous occasion, and that is criticism, generally a cheap enough article. What I want is that the grounds of my proposals should be sifted. If they are based wholly on error, if there is some fatal mistake which vitiates the whole, nothing surely can be so easy as to point it out. It ought not to require ten years to hit the blot in so plain a proposition. If it can be so, let it be proved if it exists, and let us both forget the subject, for the present position of it is not creditable to either of us, and the sooner it is in that case forgotten the better for both.

But if it is that there is some good and some bad in what I have proposed, let the chaff be sifted from the wheat,—and what is good taken, what bad rejected. But if it really is, as I suppose, that my proposals are right in the main and only open to certain objections of detail, let it be acknowledged that it is so, and let us see if those objections cannot be removed, as I believe they can be easily, and do not let us go on teaching and practising what is obsolete and useless when the very existence of our country may depend on the proper application of this most important art.

CHAIRMAN: I am sure that I shall only express the sense of this meeting, in saying that we are deeply indebted to Mr. Fergusson for the very clear and able manner in which he has brought forward his system of fortification. I do not intend to offer any observations upon it myself, but I believe there are several officers present who desire to make some remarks. Colonel Wilford, I believe, is one.

Colonel WILFORD, R.A.: I would beg leave to make a few remarks, and I will proceed to mention a few of the difficulties which have occurred to my mind in listening to the views and to the reasoning of Mr. Fergusson; but, before I proceed to do so, I ought to say that I consider great benefit will be derived from the discussion of the points and questions which he has mooted, and I think we owe him a great deal for the time and attention which he has devoted to the subject. Having said thus much, I shall in the first place make a few remarks upon the bastion system. I admit that Mr. Fergusson has faithfully described it; but then we must consider that the first principle of fortification is the art of enabling a few men to defend themselves against a much greater number; and, therefore, the primary idea of a bastion system is to enable a few men to place them-

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selves in security, and to resist for a certain time a much greater number, and meaning by "greater number," not only a greater number of men, but that greater number of men possessing a greater power of artillery, which must be assumed to be the general condition of an attack. If we are to conceive a large state having extensive frontiers, and many points to occupy, the strong places must all have garrisons and be prepared for defence, for they cannot know upon what frontier they will be attacked. It will always be, as a general principle, conceded, that the besieger, who chooses where he shall attack, will be able to accumulate a much greater amount of means than any state can have at its command at every point of its frontier. In a great empire like ours, we may have a few points, such as Portsmouth and Plymouth at home, and we may have Gibraltar and Malta abroad, where we may accumulate immense means; but, generally speaking, it can hardly be done. Hence, taking, for example, an octagon or any smaller work, I would contend this generally, that whether it be the bastion system, whether it be the circular system, or any other system approaching it, it will be impossible to prevent that great and essential advantage, which will lie in the hands of the besiegers, of a concentric attack, and so embracing the defence. For example, looking at the model on the table, supposing that on any one side of it—at a distance of 1,000 yards—there was a line of batteries, the fire from which would converge and cross upon the defenders—then, whether it be the bastion system or the circular system, that general advantage must lie with the attack. In comparing the advantages of different forms of construction it is necessary, having no other mode to resort to, to calculate the number of days which under the given system the defence would last, such calculation being independent of the courage of the garrison, which would tend to modify it; but the assumption is, that, if there is a very great superiority in the fire of the artillery on the side of the attack, it must succeed. That must be the general result; but there are no doubt exceptional cases, as at Sebastopol. There we had an immense fortress to deal with, occupied by an army as strong, if not stronger, than the attacking army; and again, that army having free communication with its own country both parties were on an equality Again, if we suppose a fortress something like that of Antwerp, it being generally of a circular form, and the diameter very great, any given portion of the *enceinte* approaches a straight line, and some advantage will then arise to all systems, even to the bastion system, for, in that case the salient angles of the bastions become so obtuse, that the embrasures can be directed in the direction of the capitals of the bastions at will; and again, some points can be made curved. I shall not attempt to go into every point, but I will address myself to the question of enfilade; and I will refer to the model. This (pointing to the model) is the salient angle of the bastion. This line (describing the same) is prolonged, and a battery is made perpendicular to that prolongation. Some guns, I will suppose, are placed at this point (describing the same), and it would appear, that every shot would go along the *terre plein*, and strike the guns; but we find that the shot goes into the ditch, and it is very difficult to hit the guns. I do not mean to say that ricochet firing, combined with direct firing, and the fire of mortars, on the part of the attack, is not embarrassing to the

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defence, and generally in the end does not wear out a garrison, but it does not tell, as is supposed. On the other hand, it is supposed that a work, the outside of which is curved, would escape this ricochet firing. I will suppose an attack to be made against this model before us. Suppose a line of works at a thousand yards distance from the *enceinte*, or at any distance that is possible—suppose there is a battery placed where I am standing in the direction to which I am pointing, there will be a general ricochet over the whole of these lines [pointing to the same], the shot will rise, leaving the muzzle at five or six degrees of elevation; although the velocity is small, still the angle of descent is rather greater; and supposing a number of shot and shell coming down in this direction, some would graze the crest of the parapet, and some would take it obliquely; some would ricochet at that part, and some would take it in reverse. Therefore, practically, I believe it would be rather easier than more difficult to procure a general ricochet on these curved lines [pointing to the model], and the general advantage would be with the attacking party. With regard to Mallet's mortars, which have been just alluded to, I think that the inventor has tried to take too great a step at once. If he had constructed one of half the size, he might have succeeded. It is true that one firing in this or that position [describing the same] would not produce a breach, but suppose that a shot fell at that point, it would blow down that *escarpe* as in the bastion system. With regard to artillery, there is no doubt it is true that if you can so contrive a work as to be able to place your artillery on the same footing, and having the same advantage as the attacking party have, and the defenders have as much artillery, then it is one man against another, but there is great difficulty in doing it. I will endeavour to bring it in a practical way before this meeting, looking at an estimate of the expense, and taking into account 32-pounder guns. I calculate that the expense would come nearly to £1,000 a gun, that is, a gun and a thousand rounds; one hundred guns therefore would cost £100,000. I mention this to show the immensity of the thing. To work a heavy gun effectively, you would require at least ten men to a gun, seven of them to work it, and three at least for filling shells, bringing up ammunition, &c. Then you would require three reliefs, and that would make thirty men to a gun. Therefore one hundred guns would require 1,000 men, and three reliefs would make 3,000 men. It will perhaps be said that you may have auxiliaries, and that the men need not all of them be good artillerymen. I should say, in answer to that, that at least one-half of them ought to be trained artillerymen. Therefore, I conceive that it will be practically found impossible for any State to accumulate such a number of guns, ammunition, and men, as to make it possible for them to have a number equal to those which the enemy might bring to bear against certain points. Of course, with regard to a place like Portsmouth, you might accumulate such means of defence, as to be equal to what the Belgians may have at Antwerp. There is a further point worthy of notice, which is this—that although these *escarpes* [pointing to the model] cannot be seen directly, they may, under a certain combination of fire from batteries, be very seriously injured by the curved fire of very heavy projectiles. I happened to witness the breaching of Carnot's wall. After the great Revolutionary War, England agreed to rebuild the barriers of the Netherlands; and the Duke of Wellington, who

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was consulted in the matter, approved of erecting fortifications under the old system—but the Prussians said that we were wrong. They said, "You should adopt Carnot's system;" and the Duke of Wellington is reported to have asked the late Sir Alexander Dickson for his opinion, and he said at once that Carnot's detached *escarpe* could be breached. I was employed in the preparatory experiments, and I afterwards saw Carnot's wall breached in one day. That shows the difference between theory and practice, although I, at the same time, give every credit to Mr. Fergusson. There is another point, viz., "earthen parapets." Every engineer, certainly every artillery officer, will argue strongly for earthen parapets. It may be necessary to have, and often is, *escarpes* of thirty feet of masonry, and, as arms are being improved, they must be made strong in proportion. There is no doubt that we are on the eve of great improvements in artillery, and great merit is due to Sir William Armstrong for his invention. At the same time I will say, that his guns, on a large scale, are not yet made, and experience has taught me that nothing is certain in artillery till the thing is actually done; and, although a small gun may succeed, yet the plan may not answer on a larger scale. It is yet to be seen what the experiments will be.

Major JERVOIS: I think, that in order to do justice to the subject which has been brought before us this evening, it would be necessary to have the report of Mr. Fergusson's lecture before one. There are many points upon which, although I am not here as an opponent to Mr. Fergusson, I cannot but say that I disagree with him. For instance, as to his mode of his putting the question of masonry *versus* earthworks. It was mentioned by Mr. Fergusson as if the adoption of earth was new. That we know is not the case. Ever since the invention of gunpowder, earthen parapets have been used. Again, the comparison between Bomarsund on the one hand, and Silistria and Sebastopol on the other, is not to the point. The landworks at Bomarsund consisted of three or four masonry towers, all entirely above the ground, which were of course breached soon after batteries were opened against them. But the same thing would not have occurred there if the works had been constructed with sunken escarpes and with earthen parapets, the latter only appearing above ground. With regard to Silistria, the works there were simple field works, and the same may be said of those at Sebastopol, although at the latter they were more considerable. The observations, then, of Mr. Fergusson, with respect to the sieges of these three places, have no reference to the consideration of his system. The case of Bomarsund was not one of works constructed according to any system which an engineer would adopt, as against a regular land attack. I have been informed that the works at Silistria, referred to by Mr. Fergusson, had ditches only about eight or ten feet deep, and parapets of about the same width. With regard to the works at Sebastopol, their defence depended, not upon the construction of the works, but upon the enormous means for their defence, both in men and material, which the Russians possessed, and upon the facility with which they were enabled to receive reinforcements and supplies during the siege. Mr. Fergusson referred to some works now in course of construction in this country; and he said that they were works such as he would himself have designed. They are not however according to his system—they do not

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resemble it in any particular, and this leads me to think that if he were to detach his principles from his system, we should come to a better understanding; and he would find that if he came to practice, he would agree with military engineers of the modern school. There are certain things about his system that I think may be called crotchets. I think that the mode in which he proposes to apply several tiers, is a crotchet. I think also that it is a crotchet to insist on curved lines as he does, for practically there is but little difference between a curved work and a polygon, the faces of which bear in the same general direction as the curve.

It appears to me that the polygonal work has the advantage, for you have straight lines, which are more easily flanked. In the case of the curved line you have to make your *caponieres* longer than in the polygon, in order that they may perfectly flank the ditch. The straight lines, too, are cheaper in construction. With regard to the tiers, if in a long line, or in a large fortress, you choose to go to the expense of digging your ditch deep enough, and wide enough, and if you place your tiers sufficiently behind one another, that they do not incommode the gunners on the front line by shells bursting against the parapet behind them, I do not see the objection to a second tier, or, perhaps, even more *in certain cases*. But with three or four tiers in a fort of moderate size, you would have no interior space, or scarcely any. Suppose a polygonal fort of say fifty guns with tiers, as Mr. Fergusson proposes, you would have scarcely any space inside; unless the fort be of great size the rampart would fill up the interior space. Practically, it will be found that in planning works, say of the size of the detached forts round Paris, Lyons, and many of those about Coblentz, or the advanced works proposed by the Belgians, in front of Antwerp, even if it were desirable, the system of tiers could not be adopted. I commenced by observing that, in order to enter satisfactorily into the subject, it would be necessary to take the several points mentioned by Mr. Fergusson, and to come prepared, as he has come prepared, with a well digested lecture. As I have already stated, I do not appear here as an opponent of Mr. Fergusson; on the contrary, I heard what he advanced with much pleasure, and I admire him for taking so much trouble, and for devoting his time to the consideration of fortification. It is the astonishment of many what should make him enjoy it so much. But as we have an Armstrong, who has done a good turn for the Artillery, and have had a Reid, who has done a good turn for the Navy, in considering the theory of storms, I do not see why we should not have the benefit of Mr. Fergusson's observations on fortification. I think that we should feel indebted to him; I am sure I should always be glad to take counsel with him; and, although there are particular points which he has got in his head, which I call crotchets, I do not think that in putting principles into actual *practice* we should be found materially to disagree.

Colonel WILFORD: I beg to say that I know many officers of artillery feel greatly indebted to Mr. Fergusson for the questions that he has mooted, and I must say that I cannot sympathise or agree with Major Jervois in describing the ideas of Mr. Fergusson as crotchets. I think they are the ideas of a man of great talent, although I do not altogether agree with him.

Major JERVOIS: I meant the particular details of the system.

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Colonel WILFORD: I do not agree with you. With regard to the tiers, I believe, and I say it on the authority of officers who served at Sebastopol, and their belief is, that it would not be possible to fight these tiers simultaneously; particularly if shell guns were used; the men in front would be embarrassed by the effect of the fire and the burning wadding, and I doubt if you would get men steadily to fight the front tier, when the tiers behind were in action.

CHAIRMAN: Some questions relating to artillery have been discussed, and particularly with reference to improved artillery. I am happy to observe that Sir William Armstrong is present.

Sir WILLIAM ARMSTRONG: Sir, I have listened with very great interest to the lecture of Mr. Fergusson, and it certainly strikes me, from the respectful attention with which Mr. Fergusson's principles and arguments have been received—indeed it adds to my own experience an additional assurance, that emanations from civilians are not received by military and naval men in a depreciating manner. It would be mere presumption on my part to attempt to enter into the discussion of a subject which is entirely new to me. I can only discuss it in connection with that particular species of artillery to which I have given my peculiar attention. I do not know that it is open to me to say much on this occasion that would be interesting, further than with reference to the practicability of constructing large guns. That I consider to be a settled matter, and we shall infallibly have guns of a very large calibre upon the same principle—in fact, guns of that character are already far advanced, and I have no doubt whatever that in a few weeks we shall have one in operation. I am satisfied also that the effect of shells from guns of this kind will be to level any species of earthwork. I think also that they would effectually prevent the restoration of a damaged surface, and that is a matter to be considered, with reference to a system of the kind which has been described. Another point I may mention which is peculiar to long range artillery, that you will get an effective breaching fire, with a very curved trajectory, so that you will require a much higher screening place than heretofore to protect the besieged works.

Colonel WILFORD: I should like to ask you, Sir, what has been the penetration of the shells manufactured on your plan, that have been fired into earth.

Sir WILLIAM ARMSTRONG: The shells are caused to explode at such a depth as is calculated to produce the greatest effect, from six to seven feet. They explode percussively, at a depth of six or seven feet; and with a large shell, the displacement of the earth would be very complete, except upon a very extended surface; but a continued fire of shells on a face like that in the model would infallibly level it unless the screen was very high. At 2,500 yards the descending curve of the projectile would be about one in eight, and you would require one yard in eight to cover it. Eighty yards would require ten yards high to cover it. There is no difficulty in maintaining a fire upon a breached surface at night, with the same effect as in daylight, and that must be taken into account with reference to the practicability of restoring earthworks of that kind.

Colonel WILFORD: Does it strike you that your newly-invented guns

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will re-establish the equilibrium of the defence—that is to say, make the defence more certain than it is now?

Sir WILLIAM ARMSTRONG: That is a question of too technical a character for me to give an opinion upon; but I would say this in favour of earthwork generally, that I think it is the most effectual means of resisting guns of that kind. It has the advantage of being more readily restored than anything else, although I think that any species of defence would be very difficult to restore under the fire of such artillery,

Mr. FERGUSSON: I do not know that it is necessary for me to go into all the points which have been referred to; but with regard to what Colonel Wilford has said, one great point that he made, as I understand him, was the expense of such a number of guns.

Now the fact is, that a fortress of the ordinary construction, on the bastion system, has a great number of guns, nearly as many as I would ask for, and every gun must have ten men, and so on.

Give me the same number of guns as are put into an octagon of the ordinary construction, and I am content.

What I complain of in the bastion system is, that the guns are some to the right and some to the left, and some north and some east and some west, but not looking towards the enemy. Now all I want is that every gun shall point to the enemy. If that is done, it is all I contend for; and what I pretend to do, in this mode of facing the enemy by curved lines or any others, is simply that the guns, instead of being left and right, and being enfiladed, shall face the enemy, and shall not be enfiladed. With regard to blind fire and enfilade, the point is, that in the bastion system you can enfilade at from 600 to 1,000 yards, and the fire of the enfilading battery cannot be answered from the fort. But, in attempting to enfilade the lines of even such a fort as this shown in the model on the table, your enfilading battery must be placed at least 2,000 yards from the point to be enfiladed, and is within 1,000 yards of the guns of the fort, which are practically enfilading the attacking battery; so that in fact this mode of construction practically turns the tables on the attack. It is now the besiegers' batteries that expose their flank to the enemy, and become enfiladed instead of enfilading. With curves flatter than those used for an octagon the enfilading batteries must be placed at even greater distances; and with such curves as practically will only be used in future fortification they must be placed at 3,000 to 4,000 yards distant, and occasionally even more, and their flanks be practically at right angles to the fire of the fort.

Supposing Sir W. Armstrong's gun to be used, a larger treatment will be required than that shown in this model, but the principle would be the same. There is a point with regard to the number of forts which Colonel Wilford assumed would be used. That is however a strategic point, and does not belong to the subject of fortification, of which alone we are now treating, and it is a point that has been pretty well settled in Belgium, as, after erecting some 30 fortresses, a barrier of fortifications along their frontier, after the peace of 1815, they have now destroyed more than half of them, and one half of the remainder are condemned; for they find that the plan of having a number of forts and guns is all nonsense, and they

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have determined to concentrate their whole defence in Antwerp. But, as I said before, that is a strategic point, which I particularly avoided entering upon, as it was not a point to be brought forward to-night. With regard to Carnot's wall at Woolwich, the whole of the top of which was above the level of the country, all I say is this, and that goes to the remarks made by Sir W. Armstrong, that in the bastion system all the walls are above the level of the country; and if Sir W. Armstrong can, which I do not mean to dispute, breach a wall the top of which is 30 feet below the level of the country, he can much more easily breach one that is 10 feet above the level of the country. I can throw up earthworks in my ditch because I have room—because it is not seen by the enemy; but in the bastion system it is visible, it must be seen, and therefore it can be more easily breached than the other. With respect to what Major Jervois stated as to Silistria and Sebastopol, I do not wish to enter into that, as I have not the data. I prefer waiting, as I said before, until we have the actual documents, which are in the press now. All I would say at present is, that what has occurred as far as it goes is in favour of a system of earthworks. Major Jervois admits that a polygon of a high number of sides is equal to a circle, and *vice versa;* but if you take this work, which Major Jervois has drawn, there are 10 guns on one side and 10 guns on this front, and if I can put 30 or 40 guns opposite them anywhere in the field I do not believe it is possible for those 20 guns to resist. I am certain that they can be overpowered. The question with me as to fortification is this,—if the enemy can bring a greater number of guns to bear against a work than the work can bring to reply, that work must eventually be destroyed; and what I ask is,—are there any means by which that defect or that disadvantage can be remedied? I suggest a means. I do not mean to say that is the only means, or the best means, but I say here is a means. Montalembert proposed the same thing as I do, but he did it in masonry, and his system was in consequence open to many objections. At Bomarsund it was tried and it has failed, because masonry will go down. Montalembert's principle was right, but it has failed in practice, in consequence of using a material that will not resist the effects of artillery. I suggest a means of doing it by earth. Unless some other means can be suggested by which that defect, namely, the inferiority of the fire of the fort can be remedied, I am afraid fortification must remain where it has been during the last two centuries; and there is nothing, so far as I can see, that will do it except meeting the enemy face to face. If it can be done by tiers of ramparts, well and good; if not, I shall be glad to hear any other suggestion that will meet the difficulty. Major Jervois objects, not to my principles, but to what he calls certain crotchets. But let us have something better, and let the criticism of this system be the suggestion of a better mode of meeting those difficulties which I attempt to meet. In the meantime it is a system that pretends to meet certain difficulties, and if any one can improve upon it I shall be too happy to give way, and to confess that I am beaten.

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Evening Meeting.

May 21st, 1860.

Colonel P. J. YORKE, F.R.S., in the Chair.

The Chairman announced that Two Life and Eight Annual Subscribers had joined the Institution since last Meeting:

LIFE.

Bliss, Henry Baron de, late Capt. 4th Royal South Midlx. Mil.
Atkinson, J. B., Ensign 1st. Royals.

ANNUAL.

Palmes, J. P., Comr. R.N.
Ballard, J. A., Col. Beng. Engrs. C.B.
Kelly, W. D., Lieut. late Roscommon Militia.
Bastard, B. J. P., Lieut. late 9th Regt.
Raikes, Rob., Lieut. 1st Brecknockshire Rifle Vol.
Dickson, J. B., Capt. R.N.
Miller, Fredk., Major R.A.
Black, Wilsone, Capt. 6th Regt.

Also, that Seventeen Members had raised their Subscription from Ten Shillings to One Pound, and that one Life Member had paid a further composition.

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* ON THE PRINCIPLES OF FORTIFICATION ADVOCATED BY MR. FERGUSSON.

The CHAIRMAN.—I have now to ask Captain Tyler to read his paper on Fortifications. You will remember that Mr. Fergusson read a paper upon the subject last year, and it was arranged that a reply should be given by some gentleman; but owing to circumstances, the parties not being able to meet, it was put off. The great object of these discussions is of course the elucidation of truth, and not the triumph of either a person or a party; and I hope that, by the full discussion which has been and will be given, we may arrive at some distinct opinion and conviction on the subject.

Captain Tyler then read the following paper:—

About this time last year Mr. Fergusson favoured this Institution with an evening paper upon the subject of his system of fortification, the reading of which was followed by a discussion carried on by adjournment to a subsequent evening. I was sorry to be unable, in consequence of absence from London, to attend either at the reading of the paper or at the discussio n upon it; but I was afterwards requested by the Council to prepare a paper in reply to it. I consented to do so with pleasure, quite as much for the sake of an additional inducement to study the subject as to comply with the wish expressed; and I was furnished with a printed copy of Mr. Fergusson's paper, and with a manuscript copy of what others had said during the discussion upon it. It became, however, too late in the year to continue the subject in the same session, and in the meantime I devoted such leisure time as I could command to a careful consideration of the effects which rifled guns and muskets would be likely to produce upon the principles and practice of fortification.

In the present session, I determined upon *first* laying my own views before the Institution, as I had the honour to do in a lecture on the 2nd of March last, and *afterwards* continuing the discussion on Mr. Fergusson's paper; and I think that this was the fairest and most satisfactory course to pursue. In adopting it, I desired to state, as far as my own opinion was concerned, not only what principles we should avoid, but also, in contradistinction to them, those by which we should be guided in future constructions. Any who may feel inclined to do so will thus have an opportunity of discussing the principles that I have put forward, at the same time with those other principles which Mr. Fergusson and his supporters conceive to be correct.

In the paper to which I now reply Mr. Fergusson commences thus:—"It is now as nearly as possible six years since I had the honour of addressing an assembly in this place upon the subject which I am going

* It was expected that the present paper would have followed Mr. Fergusson's Lecture (which precedes it) in 1859; but the revised proofs of that lecture could not be furnished to Captain Tyler before July, and Mr. Fergusson stated that he would be unable to attend at the Institution after the 1st of August in that year. It was therefore postponed for the current year; and the two papers, with the discussions upon them, are now given *seriatim*.—ED.

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to broach this evening; but I am bound to say that I have very little to add to what I then said regarding it. Perhaps it will be considered somewhat conceited in me to say so, but I have seen no reason to alter my views; for, though there is no doubt that great progress has been made in the subject since that time, all that has passed has only tended to confirm me more and more in the correctness of the views I then enunciated. I now in consequence feel so strongly confirmed in them, that I cannot but feel that I may be justified in bringing them again before you, more especially at the present time, when everything concerning fortification is of such intense interest that I am sure I need make no apology for so doing." And he then proceeds to say: "I may also add, that, during the ten years which have elapsed since my work on fortifications was published, no one has pointed out where the error was in what I then brought forward. There has been a good deal said about details, and I do not mean to say that it was not more or less correct; but the fact that the great principles which I then proposed have been unrebutted, I believe I may say is unquestionable."

From these extracts I may, I suppose, conclude, that Mr. Fergusson admits the correctness of some of the criticisms that have been advanced upon the details of his system, but that he still adheres implicitly to his main principles, and considers that nothing has been said to refute them.

He has certainly in some measure altered his details in his later diagrams.* He has, for instance, omitted the barracks, which he designed in the first instance to stand on the summit of the made earth of which his ramparts were composed, and placed them in a better position under his ramparts. He has in his last profile omitted the fausse-braie, on which he at first so strongly relied. He has adopted counterscarps, which he formerly rejected on account of their expense. He has admitted that it may be desirable to have straight revetments instead of curved ones, though he still appears to advocate curved ramparts. He has filled up the earth behind his detached wall to give it additional strength, and he has thus abandoned the demi-Carnot wall which he at first advocated.

But I do not wish to insist upon any alterations of this description, or to tie him down in any way to questions of detail, important though they be. I desire to meet him in the fairest manner upon his own chosen ground, and to discuss the prominent questions of main principles on which he principally relies, and to which he adheres. I believe that it is with regard to these main principles that he is most in error, and that his errors in these respects are those which would if they were adopted be the most injurious.

If I thought that those main principles were correct, it would give me great pleasure to say so, and to co-operate with Mr. Fergusson, as far as I could, in making the details perfect. As I conceive them to be erroneous, I will spare no pains in endeavouring to convince him and others of the mistakes that they contain, and to demonstrate what I believe, after very careful study of the subject, to be the correct principles upon which we ought to proceed.

I concur, indeed, with Mr. Fergusson in believing that none of the

* Compare the diagrams at pp. 183, 184, with that at p. 186 of Mr. Fergusson's *Lecture*, and with the profiles given in his "*Essay*."

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systems of fortification which have been proposed or adopted since the invention of gunpowder are perfect, though I think that he has exaggerated some of their defects. I am convinced that many of the principles, even, on which they have been designed or constructed, must be altered, or materially modified; and that this is particularly the case now that superior weapons are coming into use. At the same time, I conceive that the alterations which he has proposed are not adapted, either to the weapons which we are abandoning or to those which are to supply their place, and that alterations of a more radical nature, in what I may call an opposite direction, will in the end be found to be necessary.

The defects of the French system are those on which Mr. Fergusson loves most to dwell, and he leaves the errors of the systems that have been adopted of late years by the Germans as improvements upon them, and that have received more general approval upon the continent, comparatively in the background. He even adopted, in the first instance, some of the defects which they introduced into practice, namely, the demi-Carnot wall, and the unrevetted counterscarp, which had the disadvantage of laying it still further open to the effects of distant fire from the front. It is impossible to admit the correctness of what he says with regard to the best of bastioned fortresses, that they are open to a "mode of attack (p. 180 *Lecture*) by which, without risk or danger to the besieger, the fort must fall into his hands within a certain limited number of days." The history of past sieges certainly does not bear out this assertion. In order to admit it, it is necessary to ignore all the difficulties under which besieging armies have laboured, the losses that they have sustained, the checks that they have received, the delays that they have undergone, and the failures that they have experienced, in the siege of regular fortresses during several hundred years.

But I shall pass lightly over this, and altogether over many other matters in which I cannot agree with Mr. Fergusson. I will only refer you for the present to my recent lecture at this Institution, and to a paper which I have supplied for the volume of the Royal Engineers' Professional Papers now being published, for the principal defects, both of the French and German systems, and for the principles upon which I believe they ought to be remedied; and I will come at once to those main principles of fortification, by the application of which he believes that impregnable works may be constructed, and that the defence may be rendered superior to the attack.

Those principles are easily understood. The chief of them is that which was so strongly advocated by Montalembert,—of increasing the artillery force of the garrison, and of enabling it to oppose at all points several guns from the fortress to any one that the besiegers can bring against it. Mr. Fergusson says with regard to his own system (at p. 43, *Peril of Portsmouth*,) "Gun for gun, the defence is superior to the attack, from the height at which some of the guns are placed, and the grazing fire that can be obtained from others; from the consolidation of the parapets by time, and also from the fort being able to use guns of far heavier metal than can be brought to bear against it: so that if the fort could only reply with the same number of guns it must obtain the victory. But it can always command twice or thrice or four times the number, so that battering by artillery will not avail."

But there is a great difference between them in their applications of this

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principle. Montalembert based *his* circular system on the following principles: 1. That his fortification ought to have no ditch, or rampart of earth, because it would thus be more expensive than if he employed masonry. 2. That, instead of the usual earthen ramparts, there ought to be an enceinte of gun-casemates, constructed of masonry, placed altogether above the level of the ground, and raised to a height equal to that of the rampart of a bastion system above the bottom of the ditch in front of it. 3. That this enceinte of casemates should be armed with a numerous artillery, whose great elevation should give the power of concentrating an enormously powerful fire upon all the works of the attack, of which it should render the progress impossible. 4. The importance of this enceinte of casemates in a defensive point of view would be the greater, in consequence of its having little to fear from ricochet fire,—the most effectual of all modes of attack.

Mr. Fergusson on the other hand exaggerates greatly, as I shall presently have occasion to show, the proportionate expense of masonry; he believes, with all those who have raised objections against Montalembert's designs, that exposed masonry in a fortress is too easily destroyed; and he proposes to attain the same end, of rendering successful attack impossible, in a more effectual and economical manner, by placing several tiers of earthen ramparts, one behind and one above another. It is not a little singular that Montalembert should thus have adopted tiers of masonry casemates to save the expense of earthwork, and that Mr. Fergusson, in advocating the same principle, of a preponderance of artillery fire at all points on the side of the defence, should have adopted tiers of earthwork to save the expense of masonry.

The second principle partly depends upon the first. These tiers of parapets mount to a height of 48 feet when three, or 64 feet when four of them are employed, above the level of the ground; and deep, wide ditches become necessary, in order to obtain the earth for their formation. Accordingly, when wet ditches are available,* they are to be made 200 or 300 feet, or, on an average,—say 80 yards wide; they are to contain water, 12, 15, or 20 feet deep; and they are to have no masonry revetments. When dry ditches are used, the escarps, or the escarps and counterscarps, as shown in the latest profile, are to be sunk to a depth of 30 or 40 feet below the level of the country, so as to give a total depth of 60 or 70 feet; and the ditch is to be from 50 to 100 yards wide.

The third principle consists in the employment of circular, in place of rectilinear, forms. Mr. Fergusson considers, that "many, if not most, of the disadvantages of the modern systems have arisen from the necessity of using straight-lined forms;" and he prefers circular forms, because they are the cheapest; because a circle incloses a larger space than any other mathematical figure; because it is simple; because it is more easily handled and adapted to uneven or irregular ground; because it is more easily understood, especially by undisciplined troops; and because it is the only figure which can be made equally strong in every point;—apparently cogent, but really very erroneous, reasons. I shall presently have occasion to show that circular forms applied in this manner are by no means the cheapest They inclose the smallest possible, instead of the largest, interior space in

* Vide section at p. 183, and plan at p. 184.

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Mr. Fergusson's system, because, in the inside of a bastionary, polygonal, or other trace, there are tiers of ramparts of very considerable dimensions appropriating a large proportion of that space. And, while the system is simple in theory, it would be exceedingly complicated in practice, and would involve, as I shall also have to show, the employment of enormous resources.

These, then, are the three main principles of the system proposed by Mr. Fergusson. They none of them, when taken separately, originate with him. Circular forms have been used from the most ancient times. Circular systems have been invented almost without number. Earthen ramparts in double tiers were used, for instance, by Speckle in 1589, by the Dutch, and in the bastion system of the Italians; they have since been employed, in the form of cavaliers, in bastioned systems; and Choumara shows in his work pretty much the same profile as that employed by Mr. Fergusson. Wet ditches, also, were principally used without revetments in the Low Countries in former times; and earthworks formed the great resource of the Romans. But the combination of these details into a general system in the form suggested by Mr. Fergusson, is, as far as I am aware, new in this country; though he tells us that a system very similar to it was proposed in Germany by M. Wittich in 1840, and afterwards abandoned. These principles, taken together, make up a circular sweep of fortification, or a circular fort, composed of three or more tiers of earthen ramparts, one above another, surrounded by a very large ditch, either containing a considerable depth of water, or protected by revetment or other walls sunk 30 or 40 feet below the surface of the ground; and these ramparts may be placed, as it were, on the top of an enceinte, of the French or of the German system, either of which he is willing to accept for the defence of his ditch. The system thus made up, besides being supposed to possess the great advantage of impregnability, is also recommended on account of the cheapness, as compared with other systems, with which it might, Mr. Fergusson believes, be constructed.

In considering the principles before us, I will commence with the most important of them.

It is a very proper question to discuss in the first instance, whether it is possible, or how far it is practicable, to give to the garrison of a fortified place a preponderance of artillery fire on all points from which it may be attacked, or to provide it in any way with the means of maintaining a superiority over all the guns that can be directed against any portion of its defences. This is the object that Montalembert desired, as I have shown, to accomplish in masonry, and for which he contrived, in his circular system, to direct the fire of 328 guns upon every point within 500 yards of his works. This is the object, also, for which Mr. Fergusson proposes to employ so many tiers of earthen ramparts; three or more on a larger circumference, four or more on a smaller one, besides the fausse-braie.

To this question there ought to be a reasonable answer, and yet I am bound to say that I have not hitherto seen it satisfactorily replied to. We are told upon eminent authority, that the aim of a good defence is not to provoke an artillery contest with the besieger; that a good defence does not consist in loading the ramparts with artillery; that artillery is expensive, costing 1,000*l.* per gun, including its 1,000 rounds of ammunition, or 100,000*l.* per 100 guns; that 1,000 men would be required to man every

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100 guns, and so forth. But these reasons do not seem to be as conclusive as is desirable.

Five hundred guns, with their ammunition, would thus cost, no doubt, half a million of money, and would require 5,000 men to man them; and these alone would be very serious objections to their employment in all cases for opposing (say) 200 guns on the part of the besieger. But the other points referred to are mere assertions, which do not come home to the mind, without further explanation at all events; and the subject is well worthy of full consideration. It is a grand, a simple, and a tempting idea, to place at the disposal of a garrison the means of destroying at once any batteries that can be opposed to them, whenever it may suit the pleasure of their commander to order them to their guns. Mr. Fergusson thus states this idea at page 45 of his *Essay:*—"According to this mode of attack, we find some 50 or 60 guns dispersed in small batteries, extending half-way round the fort. If such a procedure were attempted against such a fort as I am proposing, it is probable the governor would take no notice of such child's play; but, if a battery did make itself particularly obnoxious, it would only require an order to silence it, for three, four, or five times its number of guns could instantly be brought to bear upon it with every advantage of position in favour of those in the fort."

But I will now endeavour to consider this question of the practicability of employing a greatly increased force of artillery in a more detailed manner, and in a way that will be plain to all.

In a contest between two ships, from which this idea of superiority of artillery fire has partly arisen, the issue depends very much upon three things:—1. The quantity and weight of shot and shell which each can deliver with the greatest precision in the shortest space of time. 2. The capabilities of the vessels and the manner in which they are manœuvred. 3. The skill and prowess of the commanders and their crews. But the contest is not of long duration; and almost all the hands on board can generally be employed while it lasts, either in the management of the vessel or the working of the guns, the greater number being devoted to the latter duty.

In an action between a ship and a coast-battery, the same sort of rule holds good. The contest is comparatively of short duration, and the object on either side is to disable the enemy in the shortest possible time.

But, in the siege of a fortified place, the nature of the contest, the means employed for carrying it on, and the objects to be attained, are altogether different. It is true that the ultimate aim of the besieger is the capture of the place, and that that of the garrison is to prevent its capture, as well as that artillery plays a very important part in the struggle; but the steps which it is requisite to go through in order to bring about the final result, are gradual; and a mere preponderance of artillery will not prevent a fortress from being taken on the one hand, nor enable the besiegers to capture it on the other, as I shall presently show.

There are two principal operations which the besieger has to perform in the course of his attack. The one is to construct a covered road up to the fortress, and the other is to pass the ditch by which it is protected. If the ditch be wet, he must either drain away or divert into another channel the water it contains, or else he must construct bridges across it. If it be dry, he must descend into it by galleries, form a breach in the escarp wall, and

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proceed according to circumstances. At least these are the ordinary methods of attack, and these two operations, of forming a road up to the place and of crossing the ditch, are those which the garrison has mainly to prevent.

The first parallel of the besieger, and its communications, have usually been constructed before the commencement of his batteries, and a considerable portion of his trenches before he has obtained a superiority of artillery fire; and Mr. Fergusson does not propose, with all his artillery, to obtain much advantage in this respect. He says at p. 45 of his *Essay*, "I admit at once that the enemy cannot be prevented from establishing his first parallel. It is generally done by stealth, and sufficiently complete before morning to shelter his men, so that any attempt to prevent this, or disturb him in it, would require a waste of ammunition which would under no circumstances be justified."

Artillery fire, indeed, can only be partially employed with advantage for such a purpose, although I must add, that projectiles constructed on the principles employed in Sir W. Armstrong's improved *case*, will be capable of doing good service in this and other respects.

It is not by blowing away an occasional battery that a garrison can hope to stop their assailants. The besiegers are, or ought to be, constantly at work, constructing their batteries and advancing their trenches. When a portion of their works is destroyed they throw up more earth in other places, and they give continual occupation for the guns as well as for the musketry of the garrison, if they are opposed, as they ought to be, more or less according to the strength of the garrison, at every step of their operations. The guns of a garrison, to be of service in this respect, must be made constant use of. A vigorous cannonade, only applied now and then, however overwhelming at the moment, will have but a limited effect in retarding the besieger's progress.

The most convenient, economical, and effectual means, when it can be applied, of opposing the early operations of the besieger, and, in fact, of checking all those works on which uncovered workmen, or the method of flying sap, are employed, is by a plentiful use of musketry from convenient situations in advance of the place, for preventing their construction. The rifled muskets of modern days will be of very great utility in this respect. They will, in fact, have a tendency to render all such work in the neighbourhood of a place impossible, at least by daylight, and to compel the besieger to hide his workmen behind screens, or to employ them almost or altogether underground, where neither musketry nor artillery can disturb them.

When the besieger establishes his batteries, then Mr. Fergusson's guns come into play in the manner above referred to; and, to quote again from p. 45 of the *Essay*, the following would be, he thinks, the probable relative position of besieged and besieger:—"There is, however, no motive for dispersing the guns in this manner, in attacking this system, as there are no faces to be enfiladed; certainly not, at least, at that distance; and as all that is required, or indeed can be done, is to silence the fire of one front by direct fire from the first parallel, the besieger would probably concentrate his fire into one great battery opposite the front he proposed attacking. Supposing he put 100 guns into such a battery, the fort could easily bring more than 200 to bear upon it. If he put 200 guns into it, it must extend 4,000 feet, on which line it would be easy to direct 300 or 400 guns from

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the fort. If he put 300 guns into it, his battery would extend nearly round one-third of the fort, so that one-third of its guns (or rather embrasures, 1,300 in number,) would point directly towards it, and the fort would have 426 guns to compete with it, supposing its guns could only fire on the exact radii of the circle in which they were placed; but, as embrasures always allow of a somewhat oblique fire, a much larger number would also be available here."

I may remark in reference to this passage that I dissent from Mr. Fergusson's arrangement of placing all the besieger's guns in one huge battery, because the besieger would thereby lose the greatest advantage which he possesses, namely, that of opposing a convergent to a divergent fire, and that I should prefer to disperse such guns as I employed as much as possible into the most convenient positions that were offered by the ground.

In any case, the trenches will advance with more or less facility and rapidity, as far as the artillery is concerned, according to the means that the besiegers can bring to bear for opposing or drawing off the fire of the garrison. I am very far from underrating the advantage of having, *as far as is practicable*, a superiority of artillery fire on the side of the fortress; but I wish to show that Mr. Fergusson is not warranted in resolving the issue of a siege, as he does almost entirely, into what he calls "a fight between the two artilleries."

The garrison, as well as the besiegers, have many other duties to attend to besides that of working their heavy guns.

During the investment of a fortress they are required to extend the circle of their observations in order to prevent surprise. Retreating as the assailants advance, they must break up roads, destroy bridges, render fords useless, and remove landmarks. When a reconnaissance is to be expected they have to keep anxious watch round the exterior, to prevent the besieger from deriving more information by personal inspection than can be avoided.

On and after the opening of the trenches, they have to retard to the utmost of their power the operations of the besiegers, by musketry and other fire, from advanced positions and convenient situations; to prepare against real and false attacks; to complete their preparations on the side attacked, as the besiegers' designs are developed; and to direct their embrasures on the besiegers' batteries, as these are established.

After the opening of the besiegers' fire, a vast deal of labour is required, for keeping the parapets, the embrasures, the platforms, the magazines, and the communications in repair, as well as for the construction of such temporary or additional works as are found to be necessary.

The various flanking works must be manned by sufficient garrisons by day and by night, and proper precautions must be taken at all points against a sudden attack. Sentries must be furnished for magazines and other works; there must be provision for hospitals, prisons, and for garrison duties of all descriptions; there may be countermines to be worked; and a certain number of men must always be deducted as sick, wounded, or ineffective.

For the due execution of these numerous services it is necessary, in the garrison of a fortress as well as with an army in the field, that there should be a proper proportion of the different branches of the service; and, though this proportion will vary with circumstances, yet there is always a suitable proportion for each particular case.

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In the working of the guns, it is true, the artillery may be, and are assisted by men from the line, or others told off for that purpose; but only a certain number of the garrison can be spared, according to its strength, for this duty; and there are always, as I have shown, numerous other duties to be performed which cannot be neglected.

There is thus a limit to the number of guns that can be employed offensively with a given garrison, as well as to the number of casemates or the extent of ramparts that can be manned; and if the magnitude of the works, or the number of guns capable of being employed (besides those which are required for the immediate security of the place, and in addition to what should be provided as a suitable reserve), be increased in a much greater proportion than the numbers of the garrison, then a useless expense is incurred, and an error is committed. That maxim also is broken, which is a good one where it is not too closely observed, that a fortress should not be supplied with much more of guns, ammunition, and military stores, than is necessary for a vigorous defence, because if it should fall the surplus might then be of great use to the enemy.

The proper proportions that ought in this way to exist in a fortress between men and guns cannot, of course, be absolutely determined. It depends upon the nature of the fortifications, upon their situation, upon their condition, and upon the different duties that may be required from the garrison in connection with them; but we may acquire a general idea of what it should be by referring to actual experience, which is the best guide, when properly made use of, that we can adopt.

As the result of experience, the following data have been given, from which the number of guns and the size of the garrison required for any fortified place may be calculated, and an average determined, in the case of different-sized fortresses constructed on the French system.

For every front of fortification there should be ten guns for the immediate security of the place; and, in addition, there ought to be about 110 for what have been called 1st, 70 for 2nd, and 30 for 3rd class fortresses. The garrison should consist, also, for the immediate security of the place, of 440 men for each front, comprising 350 of the line, 10 of the cavalry, 60 of the artillery, and 20 sappers; and twice this number should be added for the fronts susceptible of attack.*

A moderate proportion of men per gun, according to this mode of computation, would allow 40 men to every piece of ordnance for an octagon on the French system,—a second-class fortress, corresponding to what Mr. Fergusson has denominated his 1,000-gun fort. If the same data were taken, the garrison required for such a work as this 1,000-gun fort would be 40,000 men, instead of 6,000; and a greater number of men, as well as a greater number of guns, would thus be required for defending it than would be necessary, according to ordinary notions, for besieging it. Such an army ought not to be in need of fortifications at all, but ought to be able to encounter its enemies, equal or inferior to it as they would thus be, in the open field.

But the defensive armament is not here taken into account, though it is equal to the whole armament of an ordinary fortress; and, even if only half the usual proportion were allowed for the offensive armament,

* Vide *Aide Mémoire to the Military Sciences*, vol. i. p. 267.

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the garrison required for that alone would still amount to 20,000 men; and these ought to be able to defend themselves perfectly well in works embracing a greater extent of area, thrown up at far less expense, and altogether of a less formidable description.

This being the experience of past times as to other systems, the next question that arises is, whether there is anything in the system proposed by Mr. Fergusson which will lighten the labours of the garrison in other respects, and which will enable a larger proportion of it to be devoted exclusively to the service of the guns, in order to obtain a more powerful fire at any given point or points upon the assailants. In a system like that of Montalembert this might to some extent be the case. The men are securely lodged from the first in bomb-proof casemates, complete, and supplied with every requisite; and though such a system would be very expensive in construction, and would require an enormous garrison to maintain anything like the fire which he desires to oppose to the besiegers; yet there would be good accommodation for a great part of them, at all events, and a large proportion of them might be employed as artillerymen. But the fatal objection to this system (besides its expense and its unpractical nature) is, that it would inevitably crumble to pieces before even an inferior fire on the part of the besieger.

It is evident that in such a system as that of Mr. Fergusson, the labours of the garrison would, on the contrary, be increased in many respects. The more the tiers of ramparts were multiplied, and the greater the number of guns that were employed on them, the more severe would be the labour of maintenance and repair. The exposed position of the ramparts, and their collection together into a concentrated form, would render them the more liable to injury; and their repairs would only be effected with considerable loss of life and limb, because the displaced earth would have to be thrown up on stages by exposed workmen from the exterior of the parapets. If the whole even of a small fortress, on such a system, were prepared and placed in perfect readiness in the first instance, with platforms, embrasures, expense magazines, bomb-proof communications, and all necessary means, and if a large proportion of casemates were applied over the whole of the works, then the expense would be very great, for works that might never be required; and this is not apparently intended. In a long line of works of this description, such preparation would be quite out of the question. If the ramparts were not so prepared, then additional labour would be required to be expended in making preparations for the reception of the much greater number of guns that are to be used on any portion of the enceinte on which attacks might be made by the assailants. It would further be in the power of the besiegers to harass the garrison by means of false attacks, against which it would be necessary also for them to make preparations.

It is plain that, instead of a smaller, if anything a larger, proportion of men would be wanted in such a fortress for every gun that it contained, or rather for every gun in it that was intended for use, than has been found elsewhere to be required; that Mr. Fergusson's 1,000-gun fort would require, therefore, a larger garrison than could be accommodated in the small interior space that would remain inside its ramparts; and that the defenders, who would necessarily be employed in works constructed, and intended to be maintained, on these principles, on a large scale, would be

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so numerous that very slight works ought to be sufficient for their protection, if, indeed, they would not be able to assume the offensive, instead of shutting themselves up behind fortifications.

The conclusion is, therefore, not to be avoided—and to this I would draw particular attention—that, in order to possess the means of overwhelming an assailant in the manner proposed, and of always remaining superior to him in defensive works, wherever he may appear, greatly increased garrisons must be employed, and the legitimate object of fortification, which is to enable an inferior to defend itself against a superior force, must be almost, if not altogether, abandoned. As long as that legitimate object is to be sought after, the garrison of a fortress must still be contented with something like the more moderate allowance of artillery that it has been found practicable to employ in past times, in due proportion to the size of the works and the numbers of their defenders.

Recent experience does not set aside that of the past in this respect. "What can the man do that cometh after the king?" What can the fortress do, as far as men and guns are concerned, that comes after Sebastopol? It is not every work that can expect to have in combination, a large army for its garrison, an entrenched camp of great natural strength for its fortifications, the contents of an arsenal for its guns and munitions, those of a fleet and a dockyard for its further assistance, and freedom of communication with the open country for its supplies. But with all the men and all the guns that were at their command, and during all the time that they were afforded for their operations, the Russians were only able to muster 1,254 pieces of ordnance altogether on their works, against 814, which the Allies had in position, according to the statement of Marshal Niel, previous to the last assault.

We thus acquire a practical idea of the garrison and resources that would be required for one of Mr. Fergusson's octagon, or 1,000-gun, forts; and here I must point out, before quitting this part of my subject, that, with regard to the question of the number of guns to be employed, Mr. Fergusson has been led into a serious discrepancy. He says, at p. 42 of his *Essay*, under the head of Armament, "The only essential point that now remains to be considered is the armament. The number of guns usually considered requisite for an octagon of the dimensions I have adopted, is 150. (Aide Mémoire, vol. i. p. 52.) This, in fact, is only fit to be an *armement de sûreté*, or a defensive element, without any offensive power, and I would, therefore, propose a similar one for my fausse braye, or defensive work. As this, therefore, is never considered in estimating the expense of a front of fortification, it may be left out on both sides; but, as the *offensive* armament I am about to propose does not exist in the usual systems of fortifications, it may fairly be charged as an additional expense inherent in mine." And he thus estimates his armament for an octagon on the French system, for what has been called a second-class fortress, about two miles only in circumference. "In looking at the plan, Plate II., it will be seen that the four rear ramparts measure about 26,000 feet in aggregate length, so that, allowing twenty feet to each gun, from centre to centre, there is room on them for 1,300 guns. As this, however, is more than will be required, suppose we adopt 1,000 as the maximum. Not to complicate the matter, suppose one-fourth of these were 8-inch shell guns

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of 65 cwts., one-fourth 32-pounders of 56 cwts., and the remaining half equally divided into 24-pounders of 50 cwts. and 20 cwts. respectively; the average weight of these guns would be under 50 cwts. (47½ cwts.) which, at 15*l.* per ton, would cost 37,500*l.*, and with 1000 carriages, at 10*l.* each, would make up, say 48,000*l.*, or 6,000*l.* per front. This, of course, is an immense charge for artillery, but, if by spending 6,000*l.* in this manner you can save 60,000*l.* in masonry, no one will deny that the plan is an economical one."

But in this estimate of artillery, the cost of ammunition, which is by far the most expensive part of it, is altogether omitted, and I observe that, when Colonel Wilford pointed out to Mr. Fergusson, in the course of the discussion which ensued on the paper to which I am immediately replying, that each gun with its ammunition would cost about 1,000*l.*, Mr. Fergusson replied, "Now the fact is, that a fortress of the ordinary construction, on the bastion system, has a great number of guns, nearly as many as I would ask for, and every gun must have ten men, and so on. Give me the same number of guns as are put into an octagon of the ordinary construction, and I am content."

This estimate of the expense of the artillery given by Colonel Wilford, would, in fact, increase the cost of Mr. Fergusson's artillery from 48,000*l.* to 1,000,000*l.* as a maximum offensive armament for a fortress constructed on a radius of about three-quarters of a mile. Mr. Fergusson has, no doubt, taken this as an excessive armament; but I am compelled to refer to what he says on these points, because throughout his published works he puts forward enormous armaments as the principal element of strength in his system.

For instance, he says, at page 61 of his *Essay*,—"In the first place, it is requisite to subdue and annihilate the 1,000 guns of the upper, or offensive fort; this, as I showed before, is not an easy, if it be a practicable, operation; but till it is done the besieger can neither advance in safety to the edge of the ditch, nor attempt to establish his batteries there, and till this is done he can proceed no further; for until the revêtement is breached the fort must be considered impregnable; and situated, as it is, 20 to 30 feet below the level of the country, it cannot be touched except from the counterscarp." In this case he has 1,000 guns on his upper ramparts, in addition to those employed below as a defensive armament; and he proceeds, "Arrived here, however, the besieger must first turn his attention to the guns of the fausse braye, which are equal in number to those he can bring against them, and are intact, as he has not yet seen them." Again, at pp. 62 and 63, *Essay*, he says, "Supposing the besieger establishes 100 mortars behind his first parallel, there is nothing to prevent the fort having an equal or double number to reply to them. For this purpose it is only necessary to withdraw 100, 200, or 300 guns from the armament previously proposed, and replace them with mortars; and, as it is absurd to suppose that 1,000 guns, or anything near that number, can ever be brought into the field, this can be done without at all diminishing the relative superiority which it is necessary the fort should have."

In speaking of the strength of such works, in reference to the lines he proposes for the defence of Portsmouth, he says also, at p. 43, *Peril of Portsmouth*:—"So that if the fort could only reply with the same number of

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guns it must obtain the victory. But it can always command twice, or thrice, or four times the number, so that battering by artillery will not avail."

But Mr. Fergusson stated, in reply to the discussion on his paper of last year, "What I complain of in the bastion system is, that the guns are some to the right and some to the left, and some north, and some east, and some west, but not looking towards the enemy. Now all I want is, that every gun shall point to the enemy. If that is done, it is all I contend for; and what I pretend to do in this mode of facing the enemy by curved lines or any others, is simply that the guns, instead of being left and right, and being enfiladed, shall face the enemy, and shall not be enfiladed."

Now, it will be observed, that what Mr. Fergusson does is this: he first proposes to take the whole 150 guns that are considered sufficient in practice, in the case of a French fortress, for his defensive armament, or "armement de sûreté," and, hiding all these in his flanks, or in his fausse braie, to employ 1,000 guns, or guns and mortars, in addition to them, for offensive purposes. And, while exhibiting the strength of his system, he displays the full advantage of the superiority which he thus commands in guns or mortars, or both, to any weapons that the besieger can bring against him. But he afterwards, to avoid the great expense of this arrangement, drops the extra offensive armament of 1,000 guns and mortars altogether; he takes the 150 guns of a French fortress only; he places them all fronting towards the enemy; he has none left for fausse braie or flanks; he leaves his work without flank defence; and yet he remains to all appearance as strong as before.

It is absolutely necessary in every fortified work that some guns should look to the right, and some to the left, and it is desirable to have also as powerful a fire to the front as is practicable; and we should have, in fact, in Mr. Fergusson's systems, more guns looking to the right and left than in the French system, if he were to absorb the whole armament of a French system to act as his defensive armament only, and to employ the extra number referred to for offensive purposes. In fact, he shows as many as 80 embrasures, in the plan that is published with his *Essay*, in one bastion only, which would, if they were occupied, at once absorb the half of his defensive armament. But it is impossible, if he omits this enormous offensive armament, that he can retain his strength, or can act upon the main principles that he has put forward; and I may add, that his ramparts without his extra guns would not stand him in much stead, any more than his guns without extra ammunition, or his ramparts, guns, and ammunition, without a very largely increased garrison.

There is one circumstance, however, which will no doubt occur to many who are present, and to which it will be desirable to allude, in reference to the effect that will be produced on the attack and defence in this respect by the introduction into use of lighter, breach-loading cannon. In future, a greater number of guns will be capable of being served by the same number of men, because each gun will be more easily transported from place to place, and will require fewer hands to work it. This fact did not enter into the calculations of Mr. Fergusson, or into those of Montalembert, of course, because they put forward and advocated the principle in question, together with their systems of fortification for carrying it out, before there appeared to be any likelihood of weapons of this description

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being employed. But it would certainly favour their views to some extent, if it were not for other circumstances which must also be taken into consideration. These are:—1. That vastly increased areas will have to be inclosed, and fortifications of far greater extent to be constructed. 2. That their garrisons will have still more work to do, and greater spaces to defend; and that, therefore, a smaller proportion of them than before will be available for artillery duties at particular points. 3. That the light guns of the besieger will be able to cope with the heavier guns of the besieged. 4. That the besieger will be able to bring a greater force of artillery to bear, and that it will therefore be still more difficult for the garrison to overwhelm him. The besieger will, in fact, only require heavy guns in future for purposes of destruction. For opposing the artillery of the garrison, his light guns, which will have equal range and accuracy, and which he will be able to employ with greater facility, will, in most cases, be far more useful to him.

It does not, therefore, on the whole, appear likely, in any case where the proportions of men upon which it is fair and reasonable to calculate, are engaged in the attack and defence, that it will be more possible in future, than it has been found to be in past times, for a garrison to overwhelm, or permanently to check, its assailants by means of a superior force of artillery. If they could always command a supremacy of that arm at any point on which they might be attacked, it would be, no doubt, as I have said before, a great advantage to them; but it would neither, as I shall show presently, stop the progress of the besieger, nor is it, when taken alone, that which would delay him most effectually in his approaches to a fortress.

As the garrison must thus in some degree be limited in its offensive powers, and as it can only make use of a given quantity of artillery in proportion to its own numbers, the next point to be discussed is, whether it will be practicable or desirable to employ several tiers of earthen parapets one above the other, on which to mount the guns which it *does* possess or can be advantageously provided with. With reference to this point I may quote a remark from M. Mangin's "Memoire sur la fortification polygonale," which has been thus translated by Sir Howard Douglas:—"In fact, on the rampart of an enceinte having the form of a simple polygon, it may be possible to place 390 pieces of artillery in opposition to the besieger's batteries; while, on a bastioned enceinte having the same number of fronts, only 260 pieces could be placed to answer the same purpose. This last number of pieces is, however, greater than it has been found possible to employ in any fortress hitherto besieged." And there follows upon this a further remark, which has especial reference to what I have previously said:—"The number of men required to serve this quantity of artillery is far greater than it has been found possible to maintain or employ in any fortress hitherto besieged; and the amount of labour in executing and keeping in repair so many embrasures, platforms, and traverses, would exceed the powers of any garrison which it would be prudent to leave in a place. The reasoning of Montalembert is, therefore, without force, practically speaking: it may be observed also, that the besieger has greater facilities than the defender for extending his operations; and he has the advantage of being able to occupy with his artillery positions which permit

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him to employ that convergency of fire, in which the superiority of the attack to the defence in a great measure consists." Again (p. 138), "Mais les anciens fronts fournissent dejà, pour les feux directs, plus d'emplacement que n'en peut occuper l'artillerie d'une place assiégée." M. Mangin is arguing in favour of the bastioned, and against the polygonal, or German system; and his argument is this:—There is no advantage to the polygonal system in consequence of its enabling its defenders to employ 390, instead of 260, pieces of ordnance on the ramparts of a fortress in opposition to the batteries of the attack, because it has not been found practicable to employ even the latter number in any fortress hitherto besieged. If this be the case, how much less necessary must it be to incur the expense of constructing the extra tiers of ramparts proposed by Mr. Fergusson.

For the active artillery operations of the defence, there is required, not only the most powerful fire that can be practically obtained, but also that which it is most difficult to silence. The guns and gunners must, if they are to act at the greatest advantage, be protected in the best manner; and the garrison must be in a position to use their weapons most effectively against their assailants; and I will add, though I do not wish to uphold the French system, that for this purpose the cross fire which is afforded by the bastioned outline is not to be despised, and is in some respects of more avail than direct fire; just as a convergent is in all cases more to be dreaded than a divergent fire. The number of guns in the possession of the garrison being in practice necessarily limited, as well as the number of men, they should evidently be together husbanded to the utmost, and be placed in positions where they can do the most mischief with the least risk. Loss of men and guns, extra labour and inconvenience in repairs and renewals, loss of time in remounting guns and replacing carriages, and other contingencies, can only be guarded against in this manner. For these reasons a small number of guns securely placed in good casemates, will be of greater avail than a greater number exposed upon open ramparts. In proof of this I will read to you a remark made by Sir Harry Jones in his official account of the operations before Sebastopol. Sir Harry says:—"The great facilities afforded by the indentation of the lines of defence, enabled the garrison to multiply *ad libitum* the flanking fire of artillery; there were some guns so admirably placed that they could not be silenced, and caused great annoyance and loss up to the last moment of the siege."

Mr. Fergusson professed himself in favour of casemates in his *Essay*, and he proposed to adopt Haxo casemates extensively; but in the *Peril of Portsmouth*, p. 45, he says, "In smaller and more confined works it might be necessary to obviate part of the inconvenience experienced from vertical fire, by covering a certain number of the guns with casemates, not of course with masonry fronts, but Haxo casemates, in which the earthen parapet and embrasure remain the same as on an open rampart, a vault only being thrown over the gun. When, however, such an extent of rampart can be obtained as is here available, this would be a useless precaution, and it would be cheaper to allow four or five guns to be destroyed than to erect one vault; besides, the advantages of light and air are so great, that I question if casemates would not be more prejudicial to the defence than otherwise."

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This was, however, written before the introduction of rifled guns, and he will now probably be disposed to change his mind in this respect. It is pretty clear that in future gun-casemates will have to be very extensively adopted, and I may demonstrate the occasion for them in a very few words.

It must be remembered that a fortress is a stationary object, and that the besiegers can adopt any measures they think proper against it pretty much at their leisure. They can ascertain their ranges with great precision before opening fire, and employ their weapons with all the accuracy of which they are capable. They may plant rifled artillery here and there in convenient situations, at 1,000 or 2,000 yards from the ramparts, and they may from time to time, as they think proper, discharge such missiles as Sir William Armstrong's celebrated *case-shells*, at high angles, in a curved trajectory, and direct them upon any portion of the ramparts they may wish to attack. The missiles from the interior of these case-shells, dropping in over the tops of the parapets, would harass the garrison very much, in many cases, even before the parapets were injured, and in some cases would make it impossible to serve the guns. They may also place sharpshooters in suitable positions at half a mile from the ramparts, and usefully employ them to produce similar effects, the curved trajectory on which the bullets travel at long ranges being ample for the purpose.

It is quite true that the garrison may annoy the besiegers in the same manner, by the fire of guns and rifles directed on their trenches and batteries, and that this effect will inevitably lead to the employment of blindages, and of underground work, on the part of the besiegers, to an extent which has not hitherto been found necessary.

But that will not better the position of a garrison having open ramparts to defend, and I think it will be evident to all upon consideration, that those guns which are securely posted, not only behind good ramparts but also under good roofs, well covered with earth, will do the best work, and will be found most annoying to the assailants in future sieges.

These gun-casemates are, however, expensive to construct. It would hardly be practicable to entertain the idea of employing them, except at intervals, along even one long line of ramparts; and it would certainly be out of the question to think of supplying them on three, four, or five tiers of ramparts, if so many could in practice be provided.

I will next proceed to investigate the cost of constructing the earthwork of these ramparts without casemates, and to show how very erroneous are the estimates which Mr. Fergusson has given.

Next to his great point of superiority of artillery fire is that of economy. He believes that he would obtain an inexpensive system of fortification by the employment of great numbers of guns upon enormous masses of earthen ramparts; and he strongly protests against the use of masonry on account of its expense, and argues in favour of the employment of earthwork on account of its cheapness.

The price which he puts down for brickwork and masonry, promiscuously, is 20*s.* a cubic yard, and earthwork, he estimates with some trouble, taking his data from canal work in this country, and from the works of foreign writers, at 3*d.* per cubic yard for ordinary systems, and 6*d.* per cubic yard for his own system. He thus makes masonry to cost 80 times

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as much as earthwork for other systems, and 40 times as much for his system.

The average prices that have been contracted for by competition, and that are being at present paid in this country for works of fortification, are, as I have taken pains to ascertain from the best authority, 9*l.* a rod, or 17*s.* 10½*d.* per cubic yard, for brickwork; 12*s.* 6*d.* a cubic yard for masonry; and 2*s.* 6*d.* a cubic yard for earthwork, including excavating, removing, forming, ramming, &c. The average cost of brickwork and masonry, therefore, would be 14*s.* 8*d.* (say 15*s.*) for the two, both being called for brevity masonry.

It thus appears that, instead of the masonry costing 80 times, it only in fact costs six times as much, for equal quantities, as the earthwork, so that the expense of six cubic yards of earthwork is equal to that of one cubic yard of masonry; and, allowing the same rate for Mr. Fergusson's ramparts as for those which are now being executed in this country, it is clear that they would cost, without adding anything for the increased *lift* that they would require in all cases, just five times as much, for earthwork alone, as the price at which he estimates them.

This very serious difference in figures upsets the whole of Mr. Fergusson's calculations. It shows that Montalembert had the truth on his side when, looking relatively to the quantities of earth and masonry that he would require, he preferred masonry to earthwork, as far as expense was concerned, rather than Mr. Fergusson when he prefers earthwork to masonry. It proves, that if Mr. Fergusson's estimate be correct, according to the prices he has assumed, his Gosport lines, instead of costing 100,000*l.* would in fact cost half a million of money for earthwork alone, a sum for which they may be completely defended, and supplied, including the purchase of the land, with fortifications, bomb-proof baracks, and every requisite, when other methods are employed.

The economical construction, then, which Mr. Fergusson holds forth as one of the chief advantages to be obtained by the system that he proposes, does not really exist; but, on the contrary, if the system which he advocates were desirable or practicable in other respects, the extra expense which it entails would go far to prevent it from being ever carried into execution, or so many tiers of ramparts from being made. In comparing its expense with that of other systems, Mr. Fergusson is in the habit of considering these latter together with their outworks, such as the tenaille, ravelin, &c. as against his own system without outworks; and, independently of the error in his prices, this course is hardly a fair one. It will give a more accurate notion of the expense of his system to compare it with that of the fortifications constructed at Paris. The enceinte which has been constructed round that city is about 20 miles long, comprising upwards of 90 bastion fronts of 300 or 400 yards each in length. Each front has been estimated on an average at 800,000 francs, or 32,000*l.*, and the complete enceinte to have cost about 3,250,000*l.* This does not include, of course, the whole of the works, because there are in addition the interior defences, the advanced forts, the armament, &c., all to be taken into account; and the cost of all of them together has been stated by one author at 8,000,000*l.* sterling; but it refers to the portion to which Mr. Fergusson's system would be affixed.

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Mr. Fergusson gives us now a very simple idea of his system, by saying that it is merely so many tiers of ramparts added on the top of a French or a Prussian system. In order to convert the fortifications of Paris, therefore, into a fortification on Mr. Fergusson's system, several extra tiers of ramparts would have to be placed behind the present ones, and the ditch, which is now 22 feet deep, would have to be made 40 feet deeper, and as much broader as would be necessary for obtaining the extra quantity of earth required to form the ramparts. Instead of cheapening the fortifications of Paris, this arrangement would clearly add to their cost just the amount which would be required to give the extra depth for the ditch and the extra mass for the ramparts that Mr. Fergusson considered to be desirable.

If 600 square yards of section were thus added over a length of 18 miles of ramparts, upwards of two and one-third millions sterling extra would be required, at English prices for ordinary ramparts, to be expended on earthwork alone.

This amount might be reduced at French prices, but would be increased by the extra height to which the earth would have to be lifted; it would be still further increased if a proportion of casemates were employed on each rampart; and it would be very much increased by any provisions that were made for roads along the ramparts, for ramps, bomb-proof communications from one rampart to another, traverses, platforms, magazines, and embrasures. I shall, at all events, be giving a very moderate estimate, in stating roughly that the cost of the enceinte would have been more than doubled, if the system which Mr. Fergusson has advocated had been employed in the construction of the works.

As a contrast to this I may quote Mr. Fergusson's calculation of the total expense of his system, compared with others, at page 60 of his "*Essay:*" "Such revetments therefore as I have been proposing ought not in ordinary circumstances to cost more than 20,000*l.* per front, an additional expense arising entirely from the absence of wet ditches without any corresponding advantage. If we add these sums to those found at page 40, it will appear that a complete form of fortification should never cost more than from 30,000*l.* (10,000 + 20,000) to 45,000*l.* (15,000 + 30,000*l.*) per front, which is about half the usual expense according to other systems."

But if these multiplied tiers of ramparts could not be practically employed in past times, in the fortresses that were then in use, how much less can they be made use of in future? Mr. Fergusson says truly that a radius of 5 miles, taken as the range of modern guns, represents a circumference of 30 miles, for the size of a fortress in which immunity from the effects of shot and shell is to be provided; and there can be no doubt that the fortifications of the future must be extended over far larger areas than it has hitherto been found necessary to occupy.

I have already given an idea of the expense of applying these tiers of ramparts and these deep ditches to a large circumference, by showing how largely the cost of the enceinte of Paris would be increased, if its ditch were deepened, and if several tiers of ramparts were added to those which it has at present; and I would now ask you to consider for a moment the question of manning and arming works of this description. In the first place, a minimum defensive armament of upwards of 1,000 guns is required for the security

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of a position covering this extent of ground, and an army always on duty to render it safe against assault. Then, again, considerable forces must be securely lodged at intervals along its whole length, in order that the enemy may be vigorously opposed, and may find a strong force before him in a proper state of preparation wherever he may make an attack. The size of the garrisons and the magnitude of the resources thus demanded, the necessity for having posts of security at intervals along lines of this extent, and considerations of economy in their occupation, all point to the conclusion that it will be desirable to fortify them by means of detached forts, rather than by continuous lines; and it will be thus seen, that, instead of the tendency being to multiply lines of ramparts in future works, it will be, on the contrary, to employ single lines of ramparts at intervals; and there can be no doubt that abundant occupation will be afforded in these latter to any garrison that can be permanently allotted for their defence. Such detached forts are already springing up in this country, and an important question with regard to them is as to the best mode of connecting them together, when such connection is required, so as to prevent an enemy from passing between them. With regard to this point, I may observe, that I do not know of any better method than by placing a self-defensible, continuous, counterscarp (or sunken wall with its back to the enemy) at a convenient distance in front of them. This would afford a sufficient *obstacle* for security against sudden attack, would be indestructible by the besieger, except by mining operations, would afford good covered communication from one end of a line to the other, and would be the cheapest continuous obstacle that could be provided in proportion to its efficiency. It would also afford protection to any temporary works thrown up behind it, when the defenders of the position could be increased in numbers, and when such works could be profitably employed in addition to the permanent ones.

I may now leave the questions of quantities of artillery and tiers of ramparts, to proceed to the consideration of the construction and the passage of Mr. Fergusson's very large ditches.

These ditches are a strong point with him; and the wet ditches particularly so. He considers, however, that neither the wet nor the dry ditches can be passed by the besieger under any circumstances.

In his application of wet ditches Mr. Fergusson follows the example of the earlier Dutch engineers, who were in the habit, down to the seventeenth century, and to the time of Coehorn, of constructing their fortresses of simple mounds of earth, disposed in suitable forms, and surrounded, as they could be so conveniently, with the water which filled up their ditches. These fortresses, we are told, at first made defences of great obstinacy, particularly in the War of Independence; and they were therefore generally approved until they were attacked by Louis XIV. They were then reduced (particularly in the year 1672) one after another, without great difficulty; and the Dutch found to their cost that they could not place the same dependence on them for the future.

The Baron de Coehorn was therefore selected to improve these Dutch fortresses, and he has earned a great name for himself by the way in which he performed the task. He found out that there was an element of weakness in wet ditches when they were used alone, and without revetments;

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and one of the greatest improvements that he is said to have effected was the combination which he introduced of wet and dry ditches.

Mr. Fergusson, however, returns to the practice of the early Dutch engineers, and prefers wet ditches without revetments as the best obstacles that he can interpose between his ramparts and their besiegers; and in considering this part of his system, I cannot do better than take the example which he has given us as being the "one by which its merits may be best tested," (p. 37, "*Peril of Portsmouth*,") namely, the lines by which he proposes to defend Portsmouth on the Gosport side.

These lines are three miles long. They consist of a ditch of that length, (p. 38, "*Peril of Portsmouth*,") nowhere less than 200 feet wide, or having less than 15 feet of water; and there are behind this ditch a fausse-braie, and three other tiers of ramparts, forming a mass of earthwork 400 feet wide and 48 feet high. The lowest of these ramparts is bent forward into the form of a bastionet at every 600 yards, in order to afford flank defence. Mr. Fergusson considers that it would be a needless waste of means to bend forward more than one line, as the real defence must always depend upon direct fire, which would be abundantly supplied by the ramparts in rear; and he observes that an additional rampart could be added to these if necessary, and should be in smaller works, as he has shown in his *Essay*. There is a covered way beyond the ditch, sunk to a depth of 10 or 15 feet below the surface, and in a curvilinear form, to secure it from enfilade, though I may observe, that it could not be so deep if the water was as high as it is shown to be in Mr. Fergusson's profile, because it would in that case be inundated with water from the ditch behind it.

This is the simple outline of the work, and Mr. Fergusson states his mode of defence in principle to be this. There are 12 miles of ramparts, and 3,000 guns could be mounted on them, while the enemy could only place 800 in one long line against them; though in practice he believes, that, besides 100 guns and 1,000 men in his bastionets, 3,000 men and from 150 to 250 guns would be sufficient to hold such ramparts "against any army or any artillery that was ever brought into the field." (P. 42, "*Peril of Portsmouth*.")

Mr. Fergusson discusses the different modes of attack that might be directed against this line of works with a better appreciation of the capabilities of the defenders than of the resources of the assailants, and he allows considerable latitude to the former in doing so. Out of these 150 or 250 guns they are always (p. 43) to have twice, thrice, or four times the number that the enemy can bring against them at any point. They are to be ready to oppose him, if necessary, with 200 guns and 100 mortars (p. 45); and the besieger (*idem*) is to find anywhere "in front of him 100 or 200 guns, securely ensconced between earthen parapets, and ready to open on him at a moment's warning." But I will read the whole of Mr. Fergusson's climax as to the impossibility of passing this ditch. (P. 45, "*Peril of Portsmouth*.") "Perhaps an officer unaccustomed to this mode of defence will realize it better if he will fancy himself ensconced with his troops in Kensington Palace and ordered to march across the Serpentine towards London. Even supposing there are no defenders or guns on the opposite side, it is no easy matter to get troops with their arms, ammunition, and clothes across a deep piece of water 200 or 300 feet wide. He must have boats, pontoons, or be allowed to build a bridge. When it comes to this he must fancy the bridges at either end

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converted into batteries of 10 guns each, sweeping the whole with a heavy cross fire; and in front of him 100 or 200 guns, securely ensconced behind earthen parapets, and ready to open on him at a moment's warning. What would he do then? Let some one explain the next manœuvre, for I cannot!"

I cannot of course admit that 3,000 men, of whom 1,000 only could be on duty at one time, and who, by the bye, are to be dispersed (p. 44, "*Peril of Portsmouth*,") over 350 acres of surface (eight men and a half to the acre), when the enemy tries to shell them, can possibly defend these ramparts in the way suggested. It would take a far larger number to perform the different duties that would be required of them if the ramparts were fully armed, and if everything were kept in readiness; but it would be out of the question with 1,000 men to move about over these lines with a couple of hundred guns, and perhaps 100 mortars also, cutting embrasures, laying platforms, and making all the necessary preparations, at any required point, according as an enemy directed his attacks.

Against such lines, so manned, armed, and defended, a besieger would have less difficulty than usual in advancing by trenchwork, because a garrison of this size would have more to do than they could possibly accomplish, and there would be fewer men than usual to spare for opposing him; but this is not the main point to which I would direct your attention, because it is not that on which Mr. Fergusson places most reliance. He does not himself attach so much importance to the advance of the trenches; but he is confident that the besiegers, even when they reached the edge of his ditch, would find it utterly impossible to pass it, on account of the quantity of direct artillery fire that he would concentrate upon them, and of the difficulty of crossing water so wide and so deep by any known means under such an accumulation of fire.

I will not attempt to enter here into any details regarding the various methods which have been employed for crossing wet ditches, but I will point out the weakness of this particular ditch, and the way in which it may be dealt with.

It so happens that the average elevation of the ground on which these lines are to be constructed is upwards of 30 feet above low-water mark, and that the bottom of Mr. Fergusson's ditch, which is twenty feet below the surface of the ground, is consequently more than 10 feet above low water. Mr. Fergusson does not say how he would fill this ditch with water, or how he would retain the water in it; but our gallant Allies, if they were to encounter it in the course of any little incursion that they might be making in force in the neighbourhood, would speedily show him how it could be emptied. They have a special and appropriate term for the operation that would apply in this instance, which goes by the name of "*saignée*." They would either make openings into it from any porous soil that might be conveniently situated in its neighbourhood, or else they would make a canal and allow the water to run out into the sea. Either of these operations being performed—and they would not be difficult of execution—the force of gravity would do the rest. The water would disappear, and the ditch would be at the service of the besiegers. None of the guns of the defenders could see into it except those in the bastionets; and *they* could not be worked if the besiegers took the precaution to enfilade them at the proper moment from the crest of the glacis or from a greater distance.

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But Mr. Fergusson has a novel and very erroneous idea as to the best mode of defending this ditch. He says (at p. 46, "*Peril of Portsmouth*"), "The use of these projections (the bastionets) is to defend the place before the regular attack is organised; once that is done, it would be perhaps as well to withdraw the guns and arm the fausse-braie with them, and trust to the more effectual direct fire for defence." I will add one word upon this subject, because it trenches upon a question of main principle of great importance. We have only to look for the result of such a proceeding in order to perceive the mistake that he has made.

The bastionets employed by Mr. Fergusson are, as I have before explained, 600 yards apart, and are calculated for 20 guns, 10 firing in one direction and 10 in the other along his ditch, though he only places 10 guns in each of them. But this latter number of guns would afford a sufficient flanking fire for the security of the ditch, provided their fire could not be silenced. So long as the water remained in the ditch, and so long as these guns could play over its surface, the passage of it would be an exceedingly difficult operation after the besieger arrived at the edge of the ditch, without any direct fire being employed in its defence. But if these guns are removed from the bastionets, or are liable to be silenced, as at present, by the besiegers looking down upon their terrepleins, the ditch becomes at once a less formidable obstacle. The 100 guns from the bastionets would be almost lost in a fausse-braie three miles long. There would be only one in every 50 yards, and they would be almost useless in this position, instead of affording a powerful flanking fire, as they would if they were properly protected in the bastionets. But more than this, when these guns are in the fausse braie, even supposing that they were all collected into one front, or one space between two bastionets, and that all the ramparts to the rear were fully occupied with guns, then not one of all these guns could see the bottom of the ditch when it was dry, and they could not any of them defend that part of the ditch which lies close under the parapets, and between the embrasures, even when the ditch was full of water. The removal of these guns from the bastionets would deprive the ditch of the most economical and most effectual defence which it could have; and this defence would be most required just at the time when Mr. Fergusson proposes to take them away—namely, when the besieger has approached towards the edge of the ditch, and is in the best position for taking his measures for crossing it.

For these reasons it will be evident, that Mr. Fergusson's proposal for securing his ditch by means of the direct fire that he considers to be most effectual for the purpose, is founded on a wrong principle, and that flank defence, at all times required, is most wanted when he would dispense with it.

But when the water has been drawn off from the ditch, in the manner above referred to, there remains what is tantamount to a breach three miles long in his works, and this flanking fire would be the only means by which it could be defended, if the guns were properly protected. As I have shown, however, they could be easily silenced, either by enfilade or vertical fire, if they were placed, as Mr. Fergusson proposes, on open bastionets.

I will not go into the question as to how the ditch should be passed if the flanks or bastionets were retained for use, and if they were properly

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protected from the fire of the besiegers, because that is a question which appertains to the ordinary principles of fortification. I think I have demonstrated, that the wet ditch by which Mr. Fergusson desires that his system should be judged, is not so difficult to cross as he believes it to be, or as it may appear to be at first sight, and that it ought not to be defended in the way in which he would defend it; and I am glad to bring forward this, also, as a good illustration of the difficulties that are connected with the employment of wet ditches without masonry revetments. Mr. Fergusson has in his works laid great stress upon wet ditches as a means of defence; and in his Lecture of last year he stated that they were by "far the best" ditches that could be employed (p. 6), and that they must now be "far wider and deeper than any yet executed." I would, therefore, say a word or two further on the subject of them in this place.

When of moderate dimensions, they are undoubtedly the cheapest obstacle, in particular situations, that the engineer can employ for the defence of his works; but they can seldom be conveniently made use of so as to be very effective; and they are always, in some respects, disadvantageous to the garrison. A dry ditch facilitates the communications of the garrison, and is at the same time an obstacle to its enemies. A wet ditch is an obstacle to both. When very broad it is still more so, and when both very broad and very deep it loses its advantage of cheapness altogether. Besides this, it impedes the action of an obstinate defence, prevents the commander of a garrison from employing his men so safely, or so conveniently, in advanced rifle pits, or in any temporary works thrown up in advance of the place, and renders any sentries or parties retained on the further side of the ditch more liable to be cut off in the dark. It is well known that the best form of ditch is that which can be made wet or dry at pleasure,—that can be constructed and employed in all respects as a dry ditch, with revetments and good flank defences, and that can be inundated at pleasure by the garrison, when circumstances render such a proceeding necessary. But when a ditch has to be filled with water from sources that can be diverted or destroyed, when the water contained in it can be drained away, or drawn off through another channel, or when the *batardeaux* which keep it up to its proper level can be ruined, then it only imparts to the garrison that trust in it a false feeling of security. I may add, however, that the arguments which I have used, though fatal to the employment of the long wet ditch proposed for these lines by Mr. Fergusson, would not apply in the same way to the case of small wet ditches surrounding detached forts on the same lines. The long ditch obstructs the communications of the whole line: the short ditches would not interfere with them. The long ditch might be drained by one operation: the others would require several operations, one for each ditch; and the advance of the enemy towards them would have to be opposed on small fronts.

The cases are not frequent, however, in which a wet ditch without revetments can be depended upon, in providing against a chance of prolonged siege operations; and it is in most cases desirable that some further means of security should be employed. I believe, myself, that it will not be necessary, or desirable, in the generality of cases, to combine an escarp, or an escarp and a counterscarp together, with a wet ditch, which has been

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hitherto supposed to be the alternative, but that it will be more advantageous to use a hollow counterscarp only, on the further side of it,—as an additional security against assault; as a safe retreat from the front, and a secure footing beyond it for the garrison; and as an obstacle which cannot be destroyed by the fire of the enemy.

I would next point out in a few words, as I have promised to do, how that the enormous dry ditch proposed to be used by Mr. Fergusson, is in reality not so formidable as he would have us to suppose. I have shown already that he could never in practice possess or employ anything like the vast means to which he refers in his works. But I would now add, that even if he had a superior force of artillery, which could not be silenced, upon works of this description, and even if the besieger, arriving with his trenches to within 80 or 100 yards of the place, could not proceed further, or, rather, if he could not, which is the position which Mr. Fergusson takes up, establish a battery upon the edge of the ditch,—there would still be no very serious difficulty in the way of his breaching the escarp, and forcing an entrance into the works.

The prescribed course, in all cases of this description, is to make what is calleda descent into tbe ditch, which merely means an underground gallery, constructed at a proper slope, leading from the surface of the ground to the bottom of the ditch. Of course, the deeper the ditch, the longer must be the gallery, in order to maintain the requisite inclination in the descent. Any number of galleries may be constructed in the same time as one gallery; and I need hardly add that the miners in the gallery are safe from the fire of the place. A great gallery, as it is called, may be constructed in average soil at the rate of about a foot per hour, or, say, in ten or twelve days for 80 yards; and, at the end of that time, the besieger is at the bottom of Mr. Fergusson's ditch. Once there, he can enlarge the openings leading into the ditch, place guns in the galleries in positions of security, and destroy the masonry revetments, both of the curtains and the flanks, at his leisure. In fact, the revetments would be entirely at his mercy, and not a single gun out of any number that there might be on the ramparts above, would be able to interfere with him. I need not follow the besieger further, as I have shown how that might be accomplished without difficulty which Mr. Fergusson has put forward as an impossibility; but I will state that there is even a precedent for this course in the operations of Vauban. When this engineer employed a miner against the escarps of the fortresses which he attacked, as he was in the habit of doing, before the operation of breaching by batteries placed on the edge of the counterscarp came into use,—he first made an opening in the escarp for the reception of his miner, by means of a gun brought down into the gallery for the purpose.

A good system of countermines, properly defended, will, however, delay the besieger in passing the last 80 yards before he comes to the ditch, more effectually than all the guns that can be directed against him from the ramparts of a fortress. These latter will not prevent his working underground, but the countermines of the garrison will always prevent him from working above ground, until they have been destroyed. It has been estimated that the besieger would be occupied for forty days, or two months, in approaching the ditch from this distance, if proper steps were taken to prevent him by this means; and I have shown that only ten or twelve days would be necessary

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if the miners of the besiegers were unopposed. It will, therefore, be seen, that a defence by countermines would always be far more effectual at this stage of the operations than a defence depending solely upon direct artillery fire; and it may be even said that in cases in which these data could be assumed to be correct, a defence by countermines alone would, setting aside the question of defensive fire, be four times as effectual at this period of a siege as one maintained by the offensive fire of 250, 500, or 1000 guns, if countermines were not employed.

These considerations, and all others with reference to the best and most economical manner in which countermines may be employed, have a very important bearing upon the question of fortifications as they should be constructed in future, because the difficulty of working above ground, under the fire of the accurate long-ranging weapons of the present day, which will be experienced in future siege operations, will certainly lead to the execution of more work underground than has heretofore been attempted.

But I have already detained you for too long a time. I must now collect together the different points which I have brought forward, and bring my remarks to a brief conclusion.

In the first place, I have attempted to prove to you, what I firmly believe myself, that the construction and employment of Mr. Fergusson's system would really be impracticable, for three reasons:—1. The great expense of the tiers of ramparts themselves. 2. The great expense of the armament that would require to be provided for them if they were to be made use of as he suggests. 3. The great numbers of the garrison that would be wanted to man them, who could least be spared in such numbers from the army in the field when they would be most required for their defence. I have shown that the object of fortification, which is to enable an inferior force to resist one considerably superior to it, would be abandoned if the garrison were to be so much increased in numbers, and were thus to be made more nearly if not quite equal to the forces by which they might expect to be attacked; as well as that a garrison so increased would not require such formidable or such expensive works for its defence. I have pointed out that wet ditches cease to be cheap when they are constructed on so grand a scale; that they are not so formidable or so desirable, and that they cannot so frequently be applied with advantage as Mr. Fergusson asserts; as well as that direct fire is not the most effectual method that can be adopted for their defence.

I have demonstrated that the progress of a siege is not so much dependent upon the issue of an artillery conflict as he represents; but that there are also other means of attack to be taken into account,—that the operations of mining in the later stages of a siege are unaffected by it,—that all the means in the power of the besieged should be employed to stop the advance of the besieger at each stage of his operations,—that a garrison must still use "the flanking fires, the mines, the sorties, and the chicane," of which Mr. Fergusson speaks in so disparaging a manner (p. 163, "*Essay*"), instead of trusting too exclusively to the power of direct artillery fire. I have pointed out a simple means by which, even if the Gosport lines were constructed and defended according to the system proposed, this ditch and these works, so impregnable in Mr. Fergusson's eyes, the only practical example he has given us, and that by which the merits of his system may

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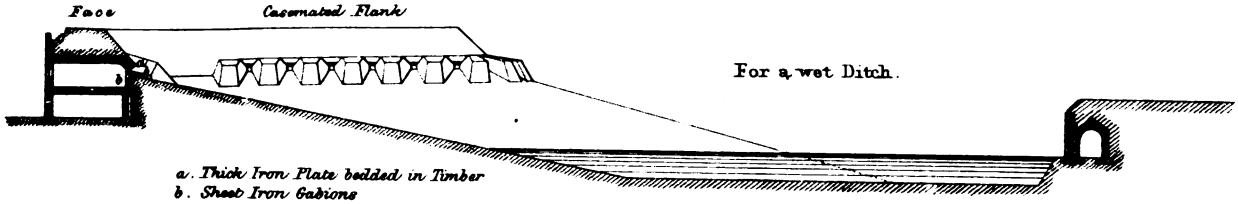
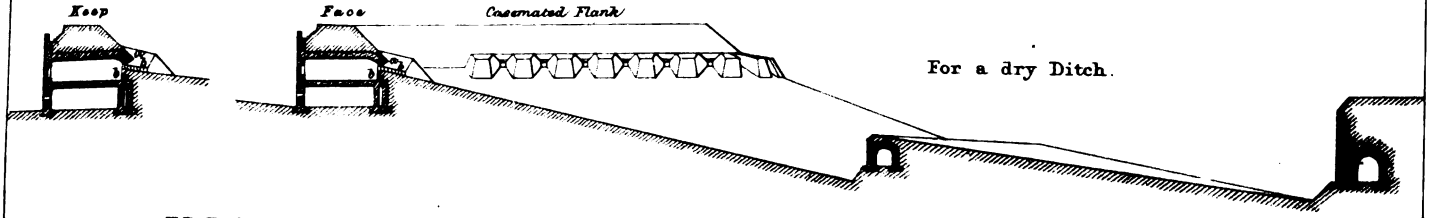
PROFILES TO ILLUSTRATE PRINCIPLES OF CONSTRUCTION PROPOSED BY CAPTAIN TYLER, R.E. FOR ADOPTION IN PERMANENT WORKS OF FORTIFICATION.



a. Thick Iron Plate bedded in Timber
b. Sheet Iron Gabions



N.B. Further diagrams, explanations, and particulars, will be found in the Volume of the Professional Papers of the Royal Engineers for 1860. p. 85. et seq.

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J.R. Jobbins

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be best tested,—would not offer very much more impediment to a besieger than they would to their garrison, and that even the dry ditch, with its walls 30 feet below the ground, could be reached by the batteries of the besieger, from a position where those batteries would not be exposed to the 1,000 guns that Mr. Fergusson would place upon his ramparts. In fine, I claim to have shown that this system is founded upon erroneous principles of defence; that it could not in practice be constructed; that even if it were to be constructed it could not be manned or armed; and that it would not after all be so formidable as it is represented to be.

But as Mr. Fergusson brings this system forward again at a time when vast improvements have taken place in the weapons of war, I am obliged to point out in addition, that it proceeds upon principles and recommends alterations just the opposite to those which appear now to be required. Instead of employing detached walls or escarps, 30 feet below the surface, and no counterscarps, as shown in Mr. Fergusson's model and his first profiles, I believe that we must now cling more to our counterscarps, and, if anything, abandon our escarps. Instead of adopting circular, we must adhere more closely to rectilinear forms, as we can by their means obtain more effective flank defence with a given number of guns, and defend a greater length of line from one point. Instead of placing tiers of ramparts upon continuous lines, we must extend our single lines of ramparts, and even break them up into detached forts, with intervals between them. Instead of an increased use of open ramparts, we must have for the permanent parts of our works such casemated ones as are required.

The question of earthworks, as advocated by himself, *versus* masonry, as advocated by his opponents, which Mr. Fergusson puts constantly forward in his lectures and publications, is not the real question at issue. Mr. Fergusson employs masonry also in his dry-ditch works; and the great difference between his system and the French systems in this respect is, that he first sinks his masonry 30 feet below the surface of the ground, and afterwards partly nullifies the advantage, of better protection for the escarp walls, which he expects to obtain from this arrangement, by increasing the width of his ditch. By the manner in which he employs his earthwork, he loses, however, to some extent the advantage of this material over masonry, by elevating it, and exposing his parapets to more easy destruction. It will be desirable, on the contrary, in future, to keep the ramparts and parapets as low as possible, whilst placing them in the most commanding situations.

I think, myself, but that is a new idea, and one which I should be glad to hear discussed, that we may, looking to the tendency of future operations, find it advantageous to dispense with escarps altogether, even in the case of dry ditches, and to adopt profiles constructed on the principles shown in the accompanying diagram.

They are designed upon the assumption that flat slopes of earth are those which will be the least exposed to destruction from the shells of rifled guns; that casemates must be very extensively employed both for guns and troops; that counterscarps will be the cheapest forms of revetment that can be efficiently employed, besides being those which the besieger would have the greatest difficulty in destroying; that they should be combined with the use of countermines, which will be required in any case in connection with future works, which would enable the garrison to oppose in the best manner

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the advance of the enemy's miner towards them, and give them the opportunity of maintaining a prolonged contest with him in any attempt he might make to destroy them.

I will now leave my case in the hands of the meeting. I have not been able, in studying Mr. Fergusson's principles, to find much in which to agree with him, as will have been plainly observed; but I nevertheless feel that he has been of great service to us all. He has pointed out the necessity that exists for fortifying our arsenals and dockyards, and Portsmouth in particular, with a strength of expression, and a felicity of illustration, that has been of great value. He has stimulated us to reflect upon and to discuss the principles of a science which is of high importance, and in which new interest is awakened, by the performances of modern weapons, and by the condition of the political atmosphere, the appearance of which betokens a coming storm of no ordinary magnitude. His works, though full, as I think, of erroneous principles, are still eminently suggestive; and I have myself taken advantage of one remark that he has made in his "*Essay*," in a way which I am happy to acknowledge. He has pointed out that the weak point of a *Haxo* casemate is the brickwork of the arch above it, and has proposed to strengthen this part by additional brickwork. I have suggested, as I think, a more effectual mode of doing so, by placing in front of it, in a slanting position, a slab of thick iron;* and this will, probably, be a good method of forming a parapet of the least destructible character, to oppose to the fire of a besieger in all future works.

I am glad to find that Mr. Fergusson has been wisely employed on a Government Commission for the consideration of the question of national defence, as I think that all opinions should be represented in such a commission; and I am sure that it must have been a source of great gratification to him to meet with such an interesting and valuable opportunity of studying his favourite subject.

MAJOR JERVOIS.—I do not wish to prolong this discussion, but, having been lately associated with Mr. Fergusson on the commission for national defences, of which he was a member, and of which I had the honor to be secretary, I wish to bear my humble testimony, and I think every member of the commission would also bear his testimony, to the value of Mr. Fergusson's presence upon that commission. It is true it was not the business of the commission to consider the details of fortifications; still the suggestions of Mr. Fergusson on this subject generally were I think of great value. I do not mean to say that everybody agreed with them, and I have before expressed my dissent from the principles of Mr. Fergusson's system; at the same time I think it showed wisdom on the part of the Government to enlist his services; and, if the House of Commons and the country at large agree to the proposals which have been made by the commission, I do not hesitate to say that it will in no inconsiderable degree be due to the presence of Mr. Fergusson upon that commission.

Mr. FERGUSSON.—I am very unwilling to rise and say much upon the subject at present, particularly because this discussion—though I hope it

* Vide diagram.

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is no longer so—has very much been considered hitherto as a dispute or quarrel between myself and the Royal Engineers.

CAPTAIN TYLER.—No; no.

Mr. FERGUSSON.—That I hope is entirely done away with now; at least, if any feeling of that sort exist it is not on my part. I have lately, as Major Jervois says, been very much mixed up with the Engineers, and I have been met with the utmost courtesy; and I hope this discussion, if it does continue, will not be considered a personal question any longer, but purely a scientific one.

With regard to the remarks of Captain Tyler, the great point I wish to remark upon is that his criticisms principally apply to what I put forward in 1850. The model before you was made in 1849 and 1850, for the Great Exhibition of 1851; and the "Perils of Portsmouth" was published in 1852. Since that time a complete revolution has taken place in artillery, consequently a complete revolution must take place in defence; whatever was good in 1850 cannot be good in 1860; and if that model was a good system of fortification in 1850, it must be a bad one now. Either I must be gifted with the spirit of prophecy, or I must have proposed a scheme so large and strange in 1850, that it would have been a thing to laugh at then. That model was made to resist the only mode of attack which was then known, the firing round shot from guns vertically. The firing shells horizontally was not then known, I believe. Paixhan had talked of it, but it was not used on land. Percussion shells were not known, and Armstrong's guns were not heard of. The whole system of gunnery has been revolutionised. If I was to propose a system now, it would not be that model or the Lines of Portsmouth; it would be entirely a new system, a new project altogether. I do not wish to put forward that model as what I propose now; quite the contrary. I should modify that to an extent that would make it quite a different thing. I believe the details of that are entirely wrong now, and I entirely repudiate them.

But there are the principles on which that system was based; the great principle Captain Tyler has remarked upon is the separation of the offensive part of fortifications from the defensive part. That appeared to me the great improvement that could be made. The defect in the bastion and the German system is that they use the same guns to flank the ditches that they use to defend the fort against distant attacks, and in placing their guns for flanking purposes they allow these guns themselves to be flanked. The great principle was to separate the offensive from the defensive. If I may be allowed to compare great things with small, I believe it may be classed very much with the improvement that Watt made in the steam-engine. When he took the steam-engine in hand he found the cylinder employed both for propelling the piston and condensing the steam, and the consequence was a loss of steam which was enormous. He suggested one vessel to propel the piston up and down and another vessel to condense the steam, and by separating the two operations he made the present steam-engines. The suggestions which I offered, and really the whole principle upon which my system is based, is that it does separate the offensive from the defensive; you place your defensive guns in security as far as possible, make them take no part in offensive operations, but reserve them till the last moment. That I believe is a principle which the Germans are using,

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which I believe is used in this country. It is becoming every day more and more the principle of fortification, and I have very little doubt that it will one day become a very important principle in fortification.

That is so far as I know the principal part of my system.

Then Captain Tyler has said something about the superiority of fire. That superiority of fire is now a new question altogether since the invention of the Armstrong and the Whitworth guns. It is a question I am not prepared to go into, because it would require diagrams. For the Whitworth guns that model is inapplicable. I admit that and give it up. To use the Armstrong guns for flanking positions, where they can be flanked, is to throw them away entirely. They are guns that must be placed in face of the enemy, and that can only be done by separating the offensive from the defensive part, and by the adoption of some means by which these guns can be placed to face the enemy, otherwise they are of no use in the fort.

The number of the garrison was also a point upon which Captain Tyler dwelt a great deal. That it is a point on which I think he is mistaken. I think he calculates the number of men from the bastion system, which requires action on the ditch, and a thousand other things, which if I am at all correct in my views are not required here. The garrison are not required in the ditch, the defence being mere artillery. I think there is a miscalculation in that. I do not see how he makes out that 40 men per gun could be required in a fort like that. However, I am entirely mistaken in my principle if he is right. Then with regard to the expense (which he made a great point of also) of earthwork as compared with masonry I can only say that I am extremely astonished. I can only say that I am prepared to take every book that has been published in Germany, France, and England, I am prepared to take the returns of the Belgian commission for the fortifications of the frontier, I am prepared to take the cost of the fortifications of Paris. All these details have been published, and relative proportion of masonry and earthwork for ramparts is as nearly as possible the proportions which I have stated; whether you take the masonry at 15*s.* or 20*s.*, and the earthwork at 2*s.* or 3*s.*, the relative proportion I believe has been published. Works I have had access to are the same; I may also say that I was a good deal at the Crystal Palace, where there was an enormous quantity of earthwork. I have had a good deal to do with contractors, and I know nothing to induce me to change my views, except to a moderate degree, as to the relative proportions of these two classes of work. I may be wrong, but Captain Tyler's view is certainly not the experience I have learned from any thing I have come in contact with of late years.

I do not know that it is worth my occupying your time; the system which is there presented, and the book I published on "The Peril of Portsmouth," I withdraw them. I admit that now a revolution has taken place in artillery they are inapplicable. It is only the principles which can be relied on, and I do not think the principles have been upset by anything that has been said this evening. I do not think the system of counterscarp is a good one; for this reason, that if artillery fire becomes less and less effective, and underground work is more used, a defence by counterscarp appears to me to be of less value, because the counterscarp being once destroyed by mines, it is the close of the defence which is destroyed, and if that is done the whole thing falls. Therefore I think something other than a counter-

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scarp defence is necessary if underground work is to be the mode employed. But in the system which I propose I do not at all exclude the use of mines. On the contrary, there is the greatest possible facility for mines, where there is no masonry to stop them. I do not know any instance of a siege where guns have been brought down by a gallery to the ditch, and where they have been used against the untouched revetment as thoroughly flanked, nay, more thoroughly flanked than any bastion system ever was. Because, if you look to my model, you will see there is not a portion of the ditch where the besieged have not the power of bringing from ten to twenty guns to bear upon it. Till the revetment is destroyed I do not see how any guns are to be established at the bottom of the ditch. I am perfectly certain that it has not been done at any siege in modern times, even after the flanks have been destroyed; therefore I do not see, while the flanks have not been destroyed and the revetment is still entire, how it can be done.

If the discussion is to be renewed, I think it ought to be renewed upon a proposal of mine suited to the present state of artillery. If I bring forward any such plan, I shall be most happy to hear what is to be said against it; but a discussion upon a thing that is a matter of antiquity would lead to no useful result.

Sir C. PASLEY.—When I first became acquainted with Mr. Fergusson I was very much pleased with him indeed. I found that he had studied every system of fortification almost that had been heard of, with some few exceptions. Perhaps he forgets Bordwine, Professor of Fortification at Addiscombe, who proposed a circular system in this country. I thought it a very remarkable thing, that a civilian should study fortification so much, and I gave him my opinion upon his works. He felt obliged to me, and I was to have taken his model, and put it into the model room of the Royal Engineer establishment at Chatham; but when he published his "*Peril of Portsmouth*," I thought little of it, considering it addressed to the popular feeling of the day. That introduced him into notice, and when he first appeared in this room to defend his system of fortification, I stated as my opinion that it was very weak indeed, because whatever number of guns he might be able to mount on successive tiers of made earth, on any portion of his circular outline, I could meet by an equal number in the same frontage in sunken batteries, one behind the other, of which the solid earth, that could not be destroyed, would be the groundwork. I would only have merlons with embrasures to oppose his guns by a direct fire, and mortar batteries, half buried in the ground, the platforms of which could not be seen into. I said that the only strength of his system was in the bastionary part, which he reprobated; for my opinion is, in spite of all that has been said either by him or by Captain Tyler, that the bastionary system is the best, and that neither Armstrong guns nor Whitworth guns, nor any guns, will alter the general principle, or do away with the advantages of that system. I shall not attack Mr. Fergusson's system now that he has given it up, and since he is of opinion, that these new inventions will make an entire change in the art of fortification. Although it has been the fashion to run down the bastionary system, I repeat that I consider it the best; that all its defects may be remedied, and that no guns will alter the art of fortification. There must always be straight lines and flanking defences. I do not agree that a high counterscarp revetment is the best protection against an assault. I

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think, as there is always an interior line of works, that the principal defences ought to be inside, and not outside of the main ditch.

Mr. FERGUSSON.—I think you said that I ignored Bordwine. If you refer to my works you will find that I mention Bordwine with the greatest possible praise, as being the person whose system I took up first, in the hopes of rendering it perfect, but afterwards I was obliged to abandon it at a certain point.

Sir C. PASLEY.—I beg to retract what I said, then; my memory is not very good.

CAPTAIN TYLER.—Mr. Fergusson began by saying that there had been a quarrel between us about his system of fortification. I can only say, as far as I am concerned, that I have never had any personal feeling against Mr. Fergusson, and that any idea of a quarrel has never entered my mind at all.

With regard to the horizontal shell firing, which Mr. Fergusson puts forward as new for destroying parapets, I may observe that it is by no means so. I have put up here some diagrams taken from Bousmard's work on fortification, in which is shown the method that he proposed for destroying an earthen counter-guard. His proposal was, to blow away the earth by degrees, by means of shells fired horizontally. He gives a number of diagrams, but I have only taken three of them. He works into the parapet in this way by degrees, and the last diagram shows the parapet completely knocked away. That is the method that has been adopted for reducing ramparts of earth as well as parapets. There is thus nothing new in the system of using shells for destroying parapets, although rifled ordnance will in some cases enable parapets to be blown away with greater ease.

The principle of separating the offensive from the defensive, which Mr. Fergusson puts forward as being the main principle of his fortification, is one that the Germans have adopted in all their recent constructions. These are almost entirely flanked by guns placed in the ditches that cannot be used offensively, and they carry out that principle in all its integrity. There is no doubt that it is a very important principle, and one which may come into play very much in future. Whether it will become universal in its application I very much doubt, because we may find out means for making parapets comparatively indestructible, and in that case we should not require to employ it. By applying iron in a slanting direction—but these things must all be tried by experiment—to the vulnerable portions of Haxo casemates, and by using flat slopes of earth instead of escarps, I think we can make our ramparts and parapets almost indestructible, and can employ our defensive fire for offensive purposes also; and if we can use our bomb-proof buildings at the same time for barracks and for casemated batteries, we shall then save expense.

When Mr. Fergusson says that we ought not to discuss this system of his because he repudiates it, I have no desire to say anything further against it. But I would remind him, that last year he brought forward the system again, in consequence of the invention of rifled ordnance; and that the reason he then gave for again bringing it forward was the same that he now advances for wishing to withdraw it, namely, that rifled ordnance had come into play.

Mr. FERGUSSON.—Was coming into play, I said. It was then an experiment; it is now a fact.

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The Journal

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LECTURES.

Tuesday, March 6th, 1860.

Colonel the Honourable JAMES LINDSAY, M.P. in the Chair.

HOW OUGHT VOLUNTEER RIFLE CORPS TO BE ACCOUTRED?

By Capt. J. M. CARTER, Adjutant Royal Monmouthshire Militia.

In answering the question, How ought Volunteer Rifle Corps to be accoutred? I am afraid that some of you will think I am expecting too much from the Volunteer Force. Should this opinion be entertained by any, I feel sure a little just consideration will dissipate it.

It is to the period of actual invasion that the practical Rifle Volunteer will look, and for it he will strive to prepare. Whether it be the colour or design of his dress, or the amount and sort of drill he should practice, or the accoutrements he should procure, he will readily admit that everything should be governed by this consideration, What will render me most efficient when my services shall be required by my country?

Evidently there has been a growing tendency to require something more from Rifle Volunteer Corps than was at first contemplated. In May, 1859, we were told by a War Office document that "it should not be attempted, as regards Rifle Volunteers, to drill or organise them as soldiers expected to take their place in line, which would require time for instruction that could ill be spared; but it should be rather sought to give each individual Volunteer a thorough knowledge of the use of his weapon, and so to qualify the force to act efficiently as an auxiliary to the regular Army

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and Militia, the only character to which it should aspire." Now the sort of impression that I received at the period in question amounted to about this, that Rifle Volunteers were to make themselves accomplished shots by some royal road.

But, although Rifle Volunteers were not to aspire to take their place in line with others of Her Majesty's Forces, they were nevertheless to aspire to act as Riflemen or Sharpshooters in the field, or, in other words, as I understand those expressions, as Light Infantry Troops, whose duties are the most difficult as well as the most important, and which consequently require the best-drilled soldiers to perform. In the present Field Exercise book you will find this fact very clearly stated. It says, "The duties of troops employed as Light Infantry in the field are both varied and important; to them the safeguard of the camp is usually entrusted, and by them the cantonments of the army are protected from the sudden or unexpected approach of the enemy. When the army is in motion, the Light Infantry reconnoitre the country in its front, feel for the enemy, or clear the way for the columns when advancing, and protect them from being too closely pressed upon or harassed when retreating; they conceal and cover the movements and manœuvres of the line, watch the motions of the enemy, and ascertain the nature of the ground and country in advance of the main body; upon their efficiency the General often very much depends for the necessary information to enable him to regulate and direct his columns."

Though these remarks were intended to apply to a more lengthened and a more systematic warfare than is likely to occur on the shores of Great Britain, still the necessity of well drilled soldiers would not be the less required for Light Infantry movements whenever an enemy invades our land. Besides, to repel effectively the landing of an enemy, it would seem more probable that it would be desirable to *concentrate* troops at certain points rather than *disperse* them, and to take up positions in battalion, rather than as Light Infantry.

The very independent action which the document referred to seems to recommend as the sole object of Rifle Volunteers, was soon, to use a military expression, undermined, for in the following July it was recommended in another document from the War Office that "the uniform and equipments of all the corps .... should be as far as possible similar .... within the same county, in order to enable the Government at any time to form the corps *into battalions*."

Again, in August 1859, "Mr. Secretary Herbert desires to impress upon the Officers of the Artillery and Rifle Volunteer Force the importance of qualifying themselves, as completely as they are able to do, for the adequate discharge of their military duties. In order to assist their efforts in this direction, he has made an arrangement with His Royal Highness the General Commanding in Chief, for temporarily attaching such officers as may desire instruction to Battalions of the Regular and Militia Artillery, and to regiments of the Line and Embodied Militia Infantry."

These memoranda evidently, to my mind, indicate that it is thought necessary Rifle Volunteer Corps should know something more than how to act as *independent* Riflemen or Sharpshooters, for independent they certainly would have to be if they were unable to perform all those duties

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in the field which a general or other officer, under whom they would on actual service be placed, would require.

The Rifle Volunteer Corps have been raised under the provisions of 44 Geo. III. c. 54. The Yeomanry and Volunteers are therein classed together. Every one who has seen the inspection of a Yeomanry regiment must know that they are as completely equipped as any regiment of Cavalry in Her Majesty's Forces, and that they perform the chief cavalry evolutions. The number of days in the year that Yeomanry regiments are drilled is 12, the number required from the Volunteer Force is 24. Why then should Rifle Volunteers not aspire to take their position in line? The amount of instruction necessary to their doing so need not be unreasonable. Let them but make themselves masters of *the company* drill, they will then (if the officers take advantage of Mr. Sidney Herbert's offer to attach themselves for a while to Regiments of the Line, or embodied Militia Infantry), be equal to the performance of any duties in battalion, as also in brigade, because, as the Drill-book says, "The evolutions of a battalion are effected by a combination of the minor movements of squad and company drill. The rules for the positions and movements of officers, non-commissioned officers, and privates, are applicable, with very few exceptions, to all the movements of a company, when in the battalion," and "A battalion may be considered to hold in a brigade or line the relative situation of a company in a battalion."

The Act of Parliament to which I have referred evidently contemplates nothing short of what I have here taken the freedom to suggest. In the 5th section it says, "No person shall be deemed, construed, or taken to be an effective member of any corps of Yeomanry or Volunteers, or shall be returned or certified as such by any commanding officer under this Act, or be entitled to any exemption under any of the provisions thereof, who shall not have duly attended, *properly armed and accoutred*, and mounted if Cavalry, at the muster or exercise of the corps to which he belongs, if Cavalry four days, if Infantry eight days at the least, in the course of the four months next preceding each Return made under this Act; unless he shall have been absent with leave, &c."

And in the 22d section it is further enacted, "That in all cases of actual invasion, or appearance of any enemy in force on the coast of Great Britain, or of rebellion or of insurrection arising or existing within the same, or the appearance of any enemy in force on the coast, or during any invasion, all corps of Yeomanry and Volunteers shall, whenever they shall be summoned by the lieutenants . . . or upon the making of any general signals of alarm, forthwith assemble within their respective districts, *and shall be liable to march* according to the terms and conditions of their respective services."

Without quoting other parts of the Act which bear upon readiness and efficiency, it is obvious that it contemplates the utmost reasonable preparation for immediate action. Though men cannot make themselves masters of a science without much practice, it would be consequently unreasonable to expect from the Rifle Volunteers equal proficiency with the Line and embodied Militia who are always at the study; but respecting equipment, no valid reason that I can see can be given why all should not be on the like footing. In the War Office Memorandum of 13 July, 1859, I find it

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stated, "Accoutrements will consist of waist-belt of black or brown leather, sliding frog for bayonet, ball-bag containing cap-pocket and *twenty*-round pouch." Subsequently a Committee of Volunteer Officers recommended a pouch to contain *thirty* rounds of ammunition and ball-bag to slide on the waist-belt to contain *ten* rounds of ammunition, in all *forty* rounds. You see the Rifle Volunteers have themselves *doubled* the number of rounds suggested in the War Office Memorandum, and I feel sure they would not have hesitated to have *trebled* it, could the same have been conveniently carried.

In bringing the subject of accoutrements specially before the Officers of Rifle Volunteer Corps and Companies I regret that, with respect to the pouch, I am somewhat late, but I could not have been sooner. During the winter, I was at Hythe for a course of musketry instruction, and at that period there was not a moment I could find to bring this subject before the establishment there, which I wished to do to get an opinion as to the merits of the accoutrements I had designed, and which it was my desire to obtain before making them public. As soon as the course was over, I delivered a lecture to the Officers and Non-Commissioned Officers of that establishment, the subject being, "How ought an Infantry Soldier to be accoutred?" and which question I answered by shewing the accoutrements which I have brought here to-day for your inspection.

The very favourable reception they met with there was the means of my interview with the Adjutant General, being to me one, I may confess, of pride, for I had the gratification of being accompanied to the Horse Guards by General Hay himself. A few days after this I went before His Royal Highness the Duke of Cambridge, and on last Thursday week before Mr. Sidney Herbert, all of whom spoke in terms of approval of the accoutrements I submitted. I expect that 100 sets will be soon ordered for trial in Line Regiments. You will see, therefore, I could not have brought the subject earlier before you.

Allow me now to make a few general remarks upon the equipment of a rifleman. I limit the word "accoutrements" to knapsack, pouch and belts, and canteen, or mess-tin as it is sometimes called, as, beyond these, I am not prepared to speak. After which I purpose to shew you the practical answer I have to give to the important question "How ought riflemen to be accoutred?"

I would beg, however, in the first place to remark, that I cannot coincide with those who hold the opinion that knapsacks and pouches may be altogether, or even partially, got rid of. Such proposals are captivating, I admit, but they are not sound. It is now eighteen years since I first directed my attention to the subject of accoutrements, and, as you may suppose, I have studied it under every aspect. I believe, however, that those who advocate the getting rid of them have become inimical to their use solely on account of their inconvenient structure and erroneous principle of suspension. Could they have seen their way to a knapsack which would not impede the free action of the soldier's arms, and in no way inconvenient except as regards weight, which more or less it is impossible to avoid, and a pouch which possessed the advantages of easy access and carriage, one would never have heard, I feel sure, of such

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Utopian suggestions as I have mentioned. I shall not detain you, therefore, by going into this question.

Most of you are aware that the Infantry soldier, according to present Regulation, has two pouches, or one pouch and one pocket. The pouch, which is worn behind, is made for fifty rounds, and the pocket, worn on the right front side, for ten rounds of ammunition, with an oil-bottle. This second pouch the brigade of Guards has not adopted. Its convenience is chiefly limited to those times when the larger pouch cannot well be brought to the front. All evidently admit that the most convenient place for the carriage of ammunition is behind the person. What is wanted is easy access to it.

The objections to a front pouch may perhaps be briefly stated to be—

1st. All excrescences on the front side of a soldier interfere with the proper handling of the rifle. That closeness of action which is so desirable, especially in the ranks, is necessarily prevented.

2d. It is an additional accoutrement.

3d. It is highly objectionable to carry any weight on the stomach.

I conceive that the whole weight of the accoutrements should fall as much as possible on the shoulders, and equally. No one, I am sure, is at all likely to dispute this, The only question is, how can the weight be made to rest there? Until lately, I believe, nothing heavier than a sword has been carried round the waist, and the weight of that, I have no hesitation in saying, should be otherwise disposed of. When the sword cannot be carried in the hand, its weight should rest upon the shoulder.

From these and other considerations, I aimed to obtain a pouch which has—

1st. Its position behind, with ready access to the ammunition. Front pouch consequently not required.

2d. Security against damp air. Freedom from dust and rust, so as to avoid the necessity of cleaning the tin inside.

3d. Places for a bottle of oil, a cramp, with turnscrew, worm, and picker, and gun rags.

4th. A magazine for copper caps.

A pouch which can contain so much, and which has space for seventy-two rounds of service ammunition, you must not expect to see so small as the one now worn by the soldier; but as it is placed behind, where size is comparatively unimportant, I have thought it right not to sacrifice the advantages I have mentioned to appearance. Notwithstanding, however, viewing the soldier as he stands in the ranks, the appearance of my pouch is actually smaller than the one previously in use, for it is, I think, an inch and a half shorter horizontally.

Belts (Pouch).

The belts of the pouch are so planned that the weight now carried upon one shoulder, and diagonally across the chest, I have distributed over both shoulders. Although I have a strap which crosses the lower part of the breast, there is no strain upon it. It is merely to keep the belts in their place when the knapsack is not worn, for when the knapsack is upon the back it can be removed.

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The necessity of disposing of the weight of the pouch and ammunition over both shoulders, in place of attempting to carry them round or partly round the waist and on one shoulder, must be apparent to you when I tell you that the weight of sixty rounds of service ammunition alone is 5 lbs. 8¼oz. The pouch without ammunition in it may be comfortable enough when supported round the waist; but, believe me, the weight say of 6 lbs. thus disposed could not be carried by the strongest man without great inconvenience, even for a short time, and for a continuance to many soldiers the most injurious consequences would result.

The Belts I have designed have these advantages also. A new set can be fitted to a man without any difficulty, and the pouch can be put on and taken off as easily as a waistcoast.

[The Pouch and Belts were then shown and put on.]

Knapsack.

When I first attempted to improve the mode of suspending the knapsack (in 1842) it was supported by means of two straps, which encircled the pack a few inches apart. A strap was attached to each, to pass over the shoulder and under the arms, terminating in a hook to fasten it to the lower part of the pack. To relieve the cutting pressure of the straps under the arms caused by the weight of the pack, a breast strap was employed, but which when tightened became so oppressive to the lungs that it was obliged to be discontinued. The present principle of suspension differs but little from the plan just mentioned; the chief difference consists in the straps which pass over the shoulders taking a more oblique direction by passing over the higher part of the shoulder so as to avoid as much as possible contact with the arms. I have myself tried several plans to obtain this grand desideratum, but all have failed except the one which I have lately had the honour of submitting to the authorities, and which I shall presently show to you.

I will just previously explain that I make the framework of the knapsack, which I consider under any circumstances useful for easy packing, subservient for most important uses. I do not make use of it only to give the pack a neat appearance, but to help its easy carriage.

The present knapsack, as you are aware, has its opening upon the side which presses against the back, whereby the more that is placed within the pack the greater does its convexity on that side become, so that a well filled pack cannot be adjusted to the back. The convexity of the pack and of the shoulder blades cause the pack to press unduly upon the small and weak part of the back. The placing of a forage cap or such like articles upon the lower part of the pack, to throw the upper part close into the neck, is at best but a clumsy and withal ineffectual remedy. The pack, however, since there is no weight in front to counterbalance it, cannot possibly ride without the discomfort I have mentioned unless provision is made *for its proper fit*. This I have effected in the most satisfactory manner, and it is this adjustment, in connection with what I may call a prolongation of the bottom of the pack to the front, that has enabled me to give the great advantage of freedom to the arms.

The side of the pack that presses against the back is in mine never

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Fig. 1.

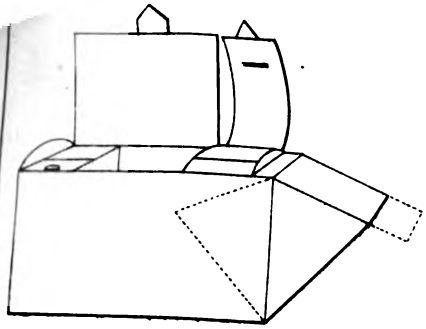


Fig. 2.

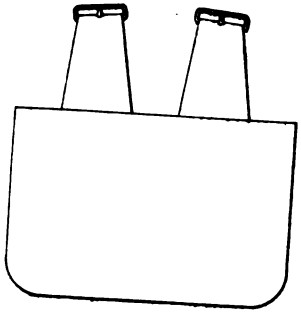
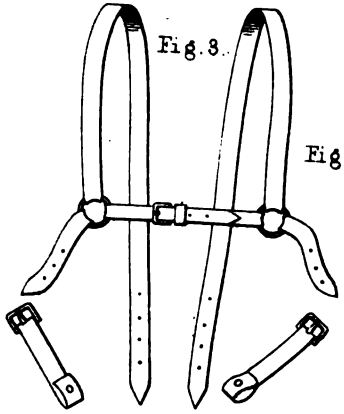


Fig. 3.



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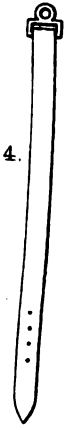


Fig. 5.

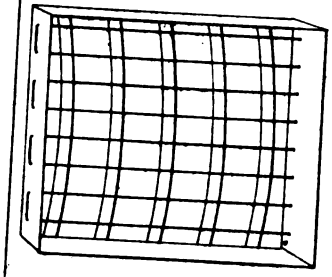
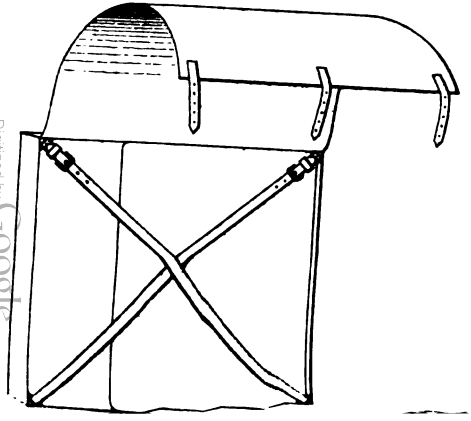


Fig. 6.



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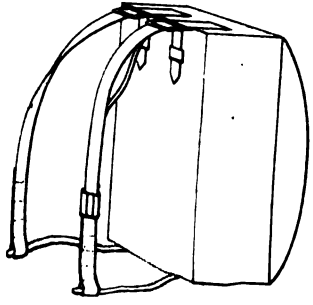


Fig. 9.

Fig. 8.

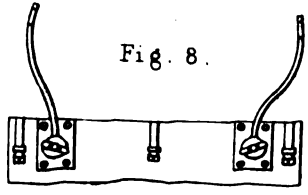
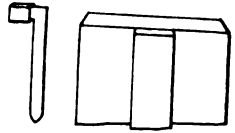


Fig. 10.



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interfered with. Whether empty or full, it always presents the same surface. Mine is opened on the outside, and it is capable of carrying more or less than the ordinary kit according to the option of the wearer, or the requirements of the service.

The great-coat I place under cover. This is a boon that has been long wished for, but has never been satisfactorily accomplished.

The canteen I prefer is of oval shape. The cover forms a good plate. By means of a handle of cylindrical form and a couple of straps attached to it, a dozen dinners can be carried to men on guard by one man, and with greater ease than he can now carry two. This handle carries the salt.

[The knapsack, &c. were here shown.]

The accoutrements that you have now seen are those which I can confidently recommend to all riflemen. Although the pouch is capable of containing a greater number of cartridges than any which has been, I believe, ever invented, it not only is thereby, and from the easy mode of suspension, the most efficient for actual service, but it is also the most convenient for the target practice ground, when ten rounds only are used at one time.

And as Rifle Volunteer Corps will require for their convenience upon *actual service* a knapsack, it is highly desirable that they should accustom themselves to wear one. The muscles which are brought into requisition for its support will be strengthened by using, and the pack will, by occasional use, be thought less of as a burden.

THE CHAIRMAN, in thanking Captain Carter for his Lecture, said that he thought the accoutrements which had been described before the meeting were well worthy of a good trial. He hoped that the authorities would order 500 sets, or at least 100, to be tried at Aldershott or elsewhere.

EXPLANATIONS OF THE PLATE.

Pouch.

Fig. 1 shews the construction of the tin of the pouch. On the left are compartments for a bottle of oil and gun rags. On the right is a magazine for copper caps. On the top of the larger lid is a place for the cramp, &c. The angular projection forms the entrance to the pouch for extracting the cartridges; when not in use, it can be closed up; it then assumes the position shewn by the dotted lines, the cover falls, and fig. 2 shews its appearance on all ordinary occasions. The outer covering of the pouch is leather, and brown leather is, I consider, the most suitable for volunteer corps, as it requires no cleaning.

The belts (fig. 3) carry the weight of the pouch on both shoulders *equally*. A strap crosses the lower part of the chest to keep the belts in their place. The ordinary waist-belt for carrying the bayonet passes over the pouch-belts behind only. The position of the pouch being exactly in

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the centre of the back, and the whole weight divided equally on the shoulders, the equilibrium of the soldier is as perfect as it can possibly be, so that no undue muscular exertion has to be used.

By means of two straight straps (fig. 4)—the two are identical—when the knapsack is worn, the pouch can be entirely supported by passing the knapsack straps (see fig. 7) through the metal loops (fig. 4), and passing the lower ends of the straight straps through the buckles, as seen in fig. 2. On a march, therefore, and indeed, on any occasion when the knapsack and pouch are not to be separated, no other belts or straps need be in front of the body, except the knapsack straps and waistbelt. By the use of these two straps moreover the carriage of *the knapsack* is actually improved. These straps also *can* carry the knapsack in the manner that knapsacks are ordinarily carried by attaching the circular metal loop (fig. 4) on to the screw at the bottom of the knapsack (fig. 9).

Knapsack.

Fig. 5 represents the frame of the knapsack, and which I consider indispensable for proper carriage and easy packing. Without a frame, a kit, when compressed, inclines to a rounded form, which is fatal to proper carriage, hence the necessity of a frame which is concave on the side that comes in contact with the back with the view of its fitting it. It becomes then a part as it were of the person, and the weight of the pack is brought as near to the centre of gravity of the wearer as it is possible to bring it. With sides moderately deep, the kit can with two straps (see fig. 6) be tightly compressed into the smallest possible space. The two iron bars on the lower side of the frame (see figs. 8 and 9) enable me to give entire freedom to the arms. While the additional weight is trifling, the advantages are very considerable, indeed it may be safely affirmed, that the pack, as shewn in fig. 7, leaves nothing to be desired; and it can now be said, that the wearing of a pack is not only not a hindrance to one's shooting well, but is actually an assistance.

On the strap which passes over the left shoulder is a metal holder for carrying the rifle at "the slope," a hook being attached to the trigger guard (see figs. 7 and 10, which are nearly full size). The hands, as well as the arms are consequently free when so desired.

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Friday, March 9th, 1860.

Captain E. G. FISHBOURNE, R.N. C.B., in the Chair.

ON MILITARY PONTOONS, WITH SUGGESTIONS FOR THEIR IMPROVEMENT.

By Captain Francis Fowke, Royal Engineers.

In reading this paper, it is not my intention to enter into any lengthened history, or to give any detailed explanation, of the principles or practice of military bridge-making or pontooning; but rather to discuss shortly and in a practical manner the merits and demerits of the system as now practised in the British service; and, as it is but unfruitful labour to stop at merely pointing out defects, I propose to introduce to you in as few words as possible a pontoon which I conceive is capable of remedying many, if not all, of the defects of the existing system.

For the benefit of non-military hearers I may be perhaps allowed to explain that, in military science, a pontoon, as understood in the British service, is a kind of boat, constructed for the particular purpose of making such temporary bridges as may be necessary for military operations in the field, in which structures it takes the place of the masonry or wooden piers of an ordinary bridge.

In building a pontoon bridge, the piers or pontoons are placed side by side in the direction of the stream; and the arches of a stone bridge are represented by beams, (or, as they are technically termed, baulks,) which are laid from one of these pontoons to the next, and covered with transverse planking (termed chesses) to form the roadway.

The construction of the pontoon bridge, as far as regards its superstructure, or bridging from pier to pier, being in principle almost the same in every instance, need not be much enlarged upon. The pontoon itself has however undergone many changes, and it is more particularly of this part of the bridge that I purpose to speak to-day; and in the first place as to the requirements to be fulfilled in the construction of the pontoon, which is to serve as the foundation for the bridge.

The principal requirements of a pontoon may be thus enumerated.

1*st*. *Buoyancy*.—As it is to be employed to support the passage of heavy bodies of artillery, cavalry, infantry, stores, &c., it must have sufficient buoyancy to carry the heaviest weights that are to be passed over.

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2*nd. Stability.*—It must also have sufficient stability to diminish as much as possible the undulating and oscillating motions that are always communicated, in a greater or less degree, to all bridges on floating supports, by the passage over them of moving loads, whether of carriages, horses, or men.

3*rd. Portability.*—As the pontoon has to be transported along with the other stores of the army, it is necessary that it should be as light as possible, and, as the land transport is often likely to be over rough country, and as, with us at least, it is happily always necessary that the pontoons should be taken to the scene of operations on board ship, it is desirable that their bulk, and especially their length, should be reduced to within the smallest possible limits.

Thus, buoyancy, stability, and portability, may be called the primary qualifications, which it is necessary that all pontoons should possess; but, besides these, there are many other objects to be arrived at in devising a perfect pontoon, such as the quality of riding easily at anchor, being easily and quickly repaired in the field, easily bailed out, or that leaks can be easily stopped when in bridge; that the roadway should be carried at a considerable height from the water; that the pontoon should be of sufficiently durable materials to stand the hard work and ill-usage that it is sure to have, both in the water and on transport; that it should be sufficiently sea-worthy not to be swamped by the swell caused by the swift current of a river, or in bad weather; and that it should be sufficiently manageable to be easily taken to or withdrawn from its place in the bridge.

Before examining the service-pattern pontoon of our army by these tests, it will be useful to see what has been done up to the present time by other nations, in the attempt to secure for their respective armies the best possible equipment in this most important particular; and it is all the more important that we should take advantage of their experience on this point as, from the fact of their peculiar geographical positions, the continental nations are more practical pontooners, and have conducted larger operations in this respect than, with a very few and brilliant exceptions, have ever been executed by the British army.

From a consideration of the different patterns of foreign pontoons, (see Plate I.) it will be seen that there are certain properties which are common to them all.

First, they are all open boats, every part of their inside being easily accessible at all times, and capable of being used as stowage room when on transport.

They all approach nearly to a common type of form, that is, they are flat-bottomed, with ends in general alike, and formed more or less like those of a Thames barge.

They are all of great breadth in proportion to their depth, the proportion being in most cases that the breadth is double the depth.

They are formed of four different materials, viz: wood, copper, tin, and lastly waterproofed canvas, but the same general form and dimensions have been preserved throughout, and the testimony of those who have had an opportunity of judging is, that they are much steadier and more stable than ours, but that these essential qualities have not been attained without a great sacrifice of weight, size, and consequent portability.

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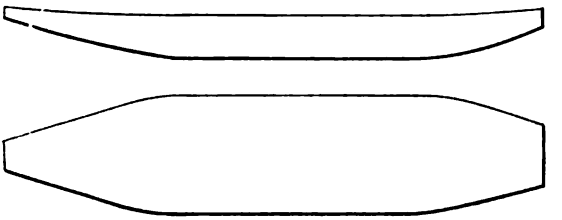
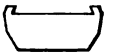
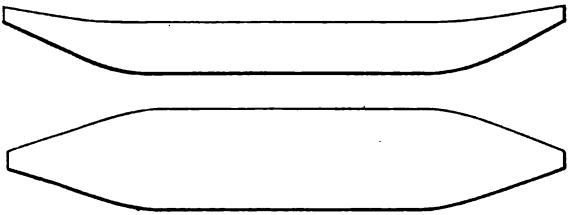
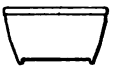
FOREIGN PONTOONS



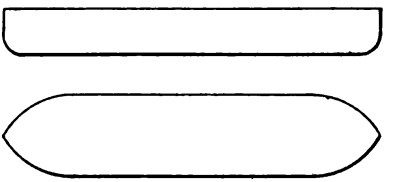


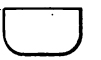
FRENCH.
WOOD.
Length 31'. 11"
Width... 5'. 10"
Depth... 2'. 7"



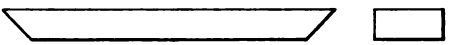


AUSTRIAN.
WOOD.
Length.. 32'. 2"
Width... 5'. 11 3/8
Depth...3'. 1"

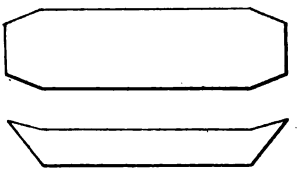


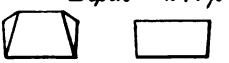


PRUSSIAN.
WOOD.
Length.. 22'. 4"
Width.... 4'. 8"
Depth.... 2'. 6"

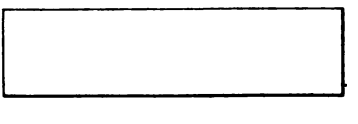


PRUSSIAN TIN.
Length.. 19'. 8 7/8
Width.... 4'. 0 3/4
Depth.... 1'. 10 1/2

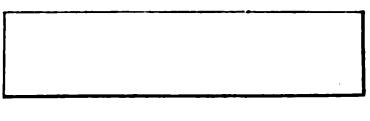




FRENCH.
COPPER OR TIN.
Length.. 16'. 6 5/8
Width.... 4'. 7 1/8
Depth 2'. 1 1/8.



RUSSIAN.
CANVAS.
Length.. 19'. 7 1/8
Width... 5'. 0 5/8
Depth... 2'. 4 3/8



OLD FLEMISH.
TIN.
Length.. 21'. 0"
Width... 4'. 10"
Depth... 2'. 3 1/8

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Having seen what is the practice of continental armies with regard to the construction, form, and dimensions of pontoons, the next point that we come to, is the pontoon at present in use in the British service, of which we have a model and diagram before us; and here we are at once struck by the fact that a very wide departure has been made from the principles which have received the sanction of all foreign powers.

The British service pontoon may be briefly described as a cylinder 2′ 8″ diameter and 22 feet long, terminated at each extremity by a hemispherical end, thus making the total length of the pontoon 24′ 8″. It is constructed entirely of tin, the internal framework consisting of a number of wheel-shaped frames, which are placed at intervals, and are connected by a central tube of the same material. By every second frame being covered with a disc of tin, the pontoon is divided into watertight compartments. The pontoon is furnished with an iron ring at either extremity, for the convenience of towing, mooring, &c., and a number of sunk handles are inserted along the sides, which, besides being of use in carrying, serve as eyebolts for attaching the superstructure to the pontoon, as also for securing it upon its carriage when being transported.

When the pontoon is to be formed into a bridge, an apparatus termed a saddle is firmly lashed to these handles, and the baulks are attached to the latter, by pins passing through them, and through the wooden cleats or chocks with which the saddles are furnished on their upper surface.

The advantages that are claimed for the tin cylinders over the open boats in use on the continent, are

1*st*. That they are lighter and consequently easier of transport.

2*nd*. That, being close vessels, they are not liable to be swamped or sunk by a swell washing over them.

3*rd*. That, being all sides alike, they can at any time be turned round, so as to bring a leak above water.

4*th*. That, as the area enclosed within a circle is greater in proportion to its enclosing line or periphery than in the case of any other figure, therefore the cylinder will give the greatest buoyancy with the least weight, of any enclosed vessel.

5*th*. That the cylinder being divided into compartments diminishes the risk of accident from leakage in the event of injury by shot or other wounds.

6*th*. That with the same sectional area the cylinder will raise the roadway of the bridge to a greater height above the water than is done by the flat boat.

7*th*. That its form admits of its being rolled into the water, instead of requiring to be lifted in or launched like a boat.

The lightness of the cylindrical pontoon as compared with the flat boat of continental nations, although striking at the first glance, yet when we come to compare the two more minutely does not appear to be so great, as for instance let us take the Prussian boat, the newest pattern of which weighs 9 cwt.; the weight of the cylindrical pontoon is rather over 5 cwt., so we may take the weights as being in the ratio of 9 to 5, the ultimate buoyancy of the Prussian pontoon is about 12,000, and that of the cylinder about 7,000, so that their buoyancy are as 12 to 7; now with this ratio of buoyancy, the proportion should stand thus: 12 : 7 : : 9 : 5¼; but, as it

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really stands 12 : 7 : : 9 : 5, it follows that the cylinder has the advantage in lightness of 5 over 5¼ or with equal buoyancies it would be lighter by only $\frac{1}{20}$th than the boat.

In actual portability, the Prussian seems to have the advantage from two causes: first, it is two feet shorter, which in itself is of immense advantage in land transport; and, secondly, the boat being open, the interior space, which is entirely thrown away in the cylinder, is available, and is actually used for the stowage of the superstructure and various stores which it is indispensable should be carried as part of a bridge equipment; so that, with equal powers of flotation, the cylinder is actually more bulky for transport than the Prussian boat pontoon.

These calculations are however all made upon the basis of the total displacement of the two pontoons, that is supposing them to be both completely immersed; but, as from the Prussian pontoon being an open boat it would be impossible to immerse it to anything approaching to this depth, it follows that it is really the fact of the cylinder being a close vessel, that gives it its great advantage over the continental open boat.

And this brings us to the second advantage claimed for the cylindrical over the boat pontoon, viz.: "That, being close vessels, they are not liable to be swamped or sunk by a swell washing over them." This is undoubtedly a strong argument for the employment of closed vessels as pontoons, but, like many other advantages, it is only purchased at the price of many drawbacks, and those of a character that cannot be lightly overlooked; one of which, viz.: the loss of stowage on transport, has been already dealt with; but a much graver one exists in the circumstance that it is impossible to examine or inspect the state of the inside framing of the vessel, and *a fortiori* to execute any repairs to this skeleton as it were of the whole structure, without pulling the cylinder all to pieces; and the consequence is, that the most trifling defect, which at the commencement might have been remedied in a few minutes, remains undiscovered, until, by the work of decay going on unobserved and uninterrupted, the pontoon finally becomes unserviceable; and, worse than this, its state is not likely to be found out until it is in actual use, when its failure will probably result in accident more or less serious, and may ultimately be the cause of frustrating an important movement.

A third defect of close vessels is, that in the case of a leak occurring it can only be kept under by pumping, and the flotation of the pontoon is thus dependent on a small and delicate instrument, which on actual service is so liable to be either lost or to get choked or out of order, whereas an open boat can be immediately and quickly bailed out with any vessel that may happen to be at hand.

The third advantage claimed is, "That, being all sides alike, they can at any time be turned round so as bring a leak above water."

This is undoubtedly an advantage, but it also has its corresponding defect, viz.: that the pontoon being of such a form that it does not matter which side is uppermost is by this fact so balanced as it were on its axis that the application of the slightest weight causes it to roll over, and thus the pontoons are rendered totally useless for employment singly, and so helpless, that in case of requiring to use one as a boat it must be coupled with its fellow before any one could get upon it, and no pontoon can be

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singly taken into its place or withdrawn from its place in a bridge, but must be formed into a raft with another pontoon before the slightest movement can be effected.

Another disadvantage is, that the deck of the vessel, which has merely to throw off an occasional wash, must be of the same strength and weight as the bottom and sides, by which the whole weight are sustained.

The waste of material caused by this form may be perhaps best understood by referring to the diagram, where it will be seen that the same quantity of covering material, if employed in a flat boat, would give a very much greater amount of buoyancy, and the want of deck might be supplied by a very much lighter material.

The next claimed advantage is, "That the cylinder being divided into compartments diminishes the risk of accident from leakage in the event of injury by shot or other wounds."

This is perhaps the most important of all the advantages claimed, but is not at all necessarily confined to the cylindrical pontoon, as it may be applied to almost any form of boat.

It is also claimed as a merit, "That with the same sectional area the cylinder will raise the roadway of the bridge to greater height above the water than is done by the flat boat."

This is true, until the cylinder is immersed up to the axis, beyond which point the immersion becomes so rapid, that any advantage on this point is more than neutralized.

Lastly, a claim is put in, "That its form admits of its being rolled into the water instead of requiring to be lifted in or launched like a boat."

Any supposed advantage that might have been gained from this circumstance has been abandoned; rolling the pontoons having been found to injure them so much as to render it impracticable.

The great disadvantage of the cylindrical form of pontoon is, that the bridge constructed with this kind of vessel is so wanting in stability and so liable to violent oscillation from side to side, as well as to rapid undulations in the direction of its length, as to occasion doubts in the minds of many able officers whether it could ever safely be employed on a campaign: as yet the cylinder is totally untried on active service, and at almost the only approach which has been made to such trial, viz. in the passage of the Thames at Chobham, the failure of this pontoon to form a serviceable bridge was complete, and resulted in the capsizing overboard of a 6-pounder gun with several men and horses; the loss of life, which might have been serious, being fortunately confined to the drowning of two artillery horses.

It has been proposed to remedy this fatal defect by increasing the number of pontoons in a bridge; but this, while adding to the difficulties of transport, will but slightly mitigate the evil, as the motions above alluded to are not caused so much by any want of buoyancy as by the form of the pontoon itself.

Both motions are caused by the sudden immersions and risings to which the cylinder is subject, the oscillations by the ends of the cylinder being alternately depressed, and the undulations by the entire cylinders successively undergoing the same movement, from the transit of heavy bodies over the bridge.

This tendency of all round-bottomed pontoons to sudden immersions is,

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as I mentioned above, entirely the result of their form, which does not give a good foundation as it were on the water. A builder in constructing the foundation of a house secures stability by spreading it out as flat and as wide as possible, and the more yielding the soil the wider he is obliged to spread it; surely then when we come to the most yielding of all substance on which we can build a foundation we ought not to act in direct opposition to this self-evident rule.

Again take the case of the bow of a boat: would any one ever for a moment expect a square-bowed or box-ended vessel to move as fast as one whose bow was more or less rounded in form? Now as it would be infinitely more difficult to force a flat end through the water horizontally, so does the rule apply to forcing a body downwards into the water; and from all these considerations it is plain that to get a stable foundation for a pontoon bridge we must have a flat-bottomed vessel to begin from.

A second cause for the sudden vertical motion of the cylindrical pontoon is from the fact of its increase of buoyancy being so rapidly lessened after the axis has been immersed, as can be readily seen from a moment's consideration of the table of immersions.

To lessen the amount of oscillation it has been necessary to make the cylindrical pontoon of such a length as to be very inconvenient on land transport; this, though of less importance on a turnpike road, becomes serious across country, a fact, I believe, that was also discovered at the Chobham campaign, when in crossing some rough country the fore end of the pontoon actually struck the wheel-horse on the back and obliged the driver to dismount rather rapidly to save his own head and back.

The last defect that I have to notice in the service-pattern pontoon is the material of which it is constructed, viz. the common tin (that is, sheet-iron tinned) of commerce, and which is liable to constant accident from defective joints and from corrosion; the most fatal being the unseen internal decay, which commences almost with the first time that a pontoon is put into the water. On transport the mere shaking and jolting of the carriages over rough country are sufficient to strain the soldered joints of the sheets of tin, and in launching from a rocky bank the greatest care and tenderness are requisite to prevent a leak being started: so much has this been felt, that cylindrical pontoons have been constructed of copper, galvanised iron, and also of yellow or Muntz's metal, a species of brass—but with so little success that we have invariably gone back to the tin, defective as it is; the copper is very expensive, so soft that a blow of a boat-hook will puncture it, and any contact with hard substances causes dents so deep and so permanent that its original form is soon lost; the additional weight of the copper is also considerable, and this objection equally applies to the galvanised iron and the yellow metal.

Before quitting the consideration of close metallic pontoons, it is necessary that we should notice another pontoon of the same class; I allude to that proposed by General Sir Charles Pasley, a lengthened description of which is not however necessary, as it has been lately so ably explained here by the distinguished inventor; but I would merely note that some of the defects of the cylinder seem to be absent from this pontoon. The sides being vertical, the rapid immersion above the axis of the cylinder is avoided. The inside is capable of being got at to a limited

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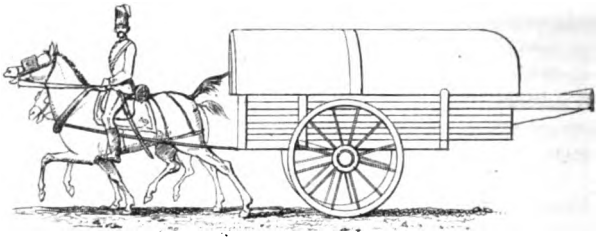
Fig. 1.



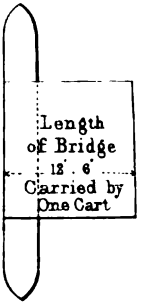
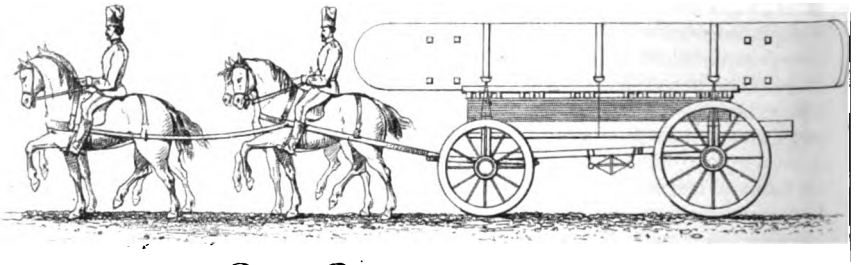
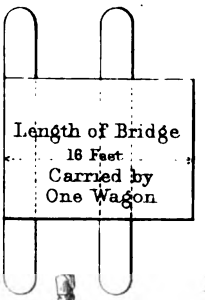


Fig. 2.





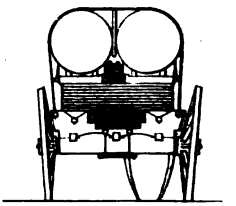
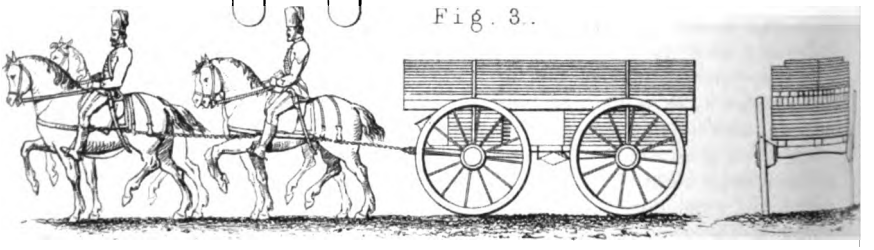
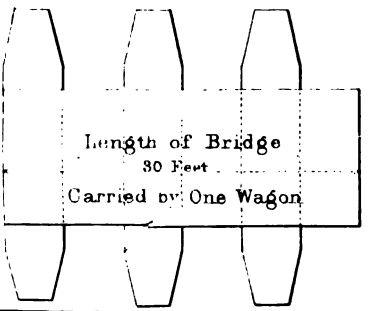


Fig. 3.





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extent, and the metal is protected by a keel. The great length of the pontoon on transport is avoided by its being divided in the centre; and copper on wood framing is substituted for tin as the material of which it is made. The narrow, unstable, rounded bottom is however still retained. The division in the centre, which throws an enormous strain on the keel lashing, introduces a new and grave source of weakness. The weight of the pontoon is increased enormously, and, although the weight of a given length of bridge is put down as less than with the cylinder, yet this advantage is only apparent, being obtained by placing the pontoons as far apart as to reduce the buoyancy of the bridge by nearly a quarter.

The method of transporting the pontoons on two-wheeled carriages (Plate II. fig. 1) is uneconomical, as two carriages, weighing together 17 cwt., are employed to carry one raft, which is carried on one carriage of 18 cwt. in the service-pattern bridge. Moreover, in crossing rough country, the jerks that would be caused by the centre of gravity of the load being rapidly shifted to points before and behind the axle would be fatal to any cattle. This last remark does not apply so much to continuous and tolerably regular inclines, up and down which I am aware the two-wheeled carts have travelled, but to a country intersected by ditches and sudden inequalities, over which I should not conceive it to be possible to transport it for any distance.

It must be besides borne in mind that, while in the service-pattern bridge the load drawn by each horse (Plate II. fig. 2) is only 1,200 lbs. or little over half a ton, that imposed upon each of the pair in the two-wheeled cart is one-third more, or 1,600 lbs., a load which it would not be safe to impose upon any one horse on active service.

Let us now take a brief summary of the various points that we have had under consideration, and we find—

That the continental flat-bottomed boat is almost every thing that could be desired as a substructure for a pontoon bridge, its only defect being the want of a deck.

That on land however it is heavy and difficult of transport.

On the other hand we find that the cylindrical pontoon has the advantage of greater lightness and portability, but that, with the single exception of its being a close vessel, it is very inferior as a bridge-former.

In the copper canoe, we find that some of the defects of the cylinder are absent, others are mitigated to a greater or less extent; but, as the ameliorations are accompanied by the introduction of fresh drawbacks, while on the whole the gains are trifling, it is a delicate question after all with which of these the balance of advantages would seem to remain, and it is not within the province of this paper to offer any opinion for or against the justice of the decision of that Committee of Officers who pronounced in favour of the cylinder to the exclusion of the copper canoe pontoon.

In both these metallic pontoons so much of the real value of a pontoon appears to be sacrificed and so little is gained in its place, that a great doubt has been raised whether our departure from the practice of continental nations has been really a step in advance. If it were, it is reasonable to suppose that some of the other European powers would have followed us, whereas I believe it will be found to be the opinion of most foreign officers that our pontoon improvements have been but a retrograde

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movement, an opinion that is shared by officers in our own service who have devoted themselves to the study of this branch of their profession; and in fact under the head of Pontoon in the *Aide Mémoire* to the military sciences I find it stated as the writer's conviction that a "a perfect pontoon bridge equipment, combining facility of transport with the quick means of passing armies over considerable rivers, does not seem to have been yet organised."

Having laid before you the difficulties of the case, and shewn what have been the various attempts to overcome them, none of which appear to have been very successful, I would now introduce to you a description of pontoon by means of which I hope to be able to shew that a satisfactory solution may at length be arrived at for this confessedly difficult problem.

The pontoon of which we have a representation (Plate III.) belongs to the class of *boat*-pontoons, and much resembles in form the wooden *bateau à ponton* in use in the French service, being flat-bottomed, nearly rectangular in plan, and with straight sides inclined outwards, so that it is rather broader above, or on deck, than at the bottom: the bow and stern (figs. 1, 2, and 4) are alike, and are somewhat similar to the bow of a Thames barge, to which vessel the boat bears a considerable resemblance. It is composed of a wooden skeleton over which is strained stout canvas, rendered waterproof by the application of a waterproofing solution. The skeleton (figs. 1, 4, 6,) consists of a number of transverse frames or ribs, which are kept in their places by two longitudinal stretchers that run through iron loops in the upper part of each frame (figs. 1 and 6), and on withdrawing the stretchers the whole boat is capable of being collapsed like the bellows of an accordion (figs. 2 and 3), the transverse frames being permanently fastened to the canvas envelope.

The end portions of the boat are decked with canvas, and the body part is partially covered by a deck of the same material, having however a narrow hatchway along the centre for the convenience of bailing out or examining the interior of the boat (fig. 4); the hatchway also gives the means of using the pontoon separately as a boat, if desired.

The dimensions of the pontoon are— length 24′, breadth 5′ 0″, depth 2′ 3″, length of the body 16 feet, length of each end 4′ 0″. The transverse frames, of which there are six, are fixed into the canvas at equal distances; over each frame a hoop is laid on the outside of the canvas, and the two are firmly riveted together with copper boat-fastenings (fig. 7). These hoops are half an inch wider than the frames, so as to project a quarter of an inch beyond them in each direction; therefore, on the pontoon being collapsed, the external hoops touch one another and form a continuous wooden case or shell for the protection of the canvas; while, from the frames being narrower, a space of half an inch is left between them, which gives ample room for the canvas to fold in without any danger of being chafed or injured by friction. These frames form the body of the pontoon, the ends decrease in width to 2 feet 6 inches at their extremities, where they terminate in transverse pieces of wood or transoms of that length (figs. 1 and 4). The transom at the stern has two holes in it, and the bow transom

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CAPTAIN FOWKE'S PONTOON.

Side Elevation.

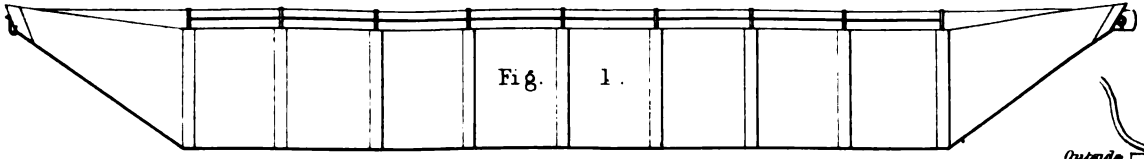


Fig. 1.

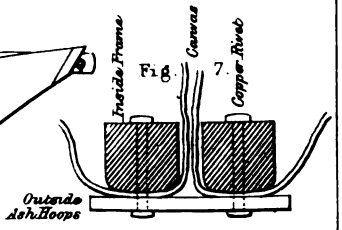


Fig. 7.

Enlarged Section of part of frame shewing provision for preserving the Canvas.

Plan.

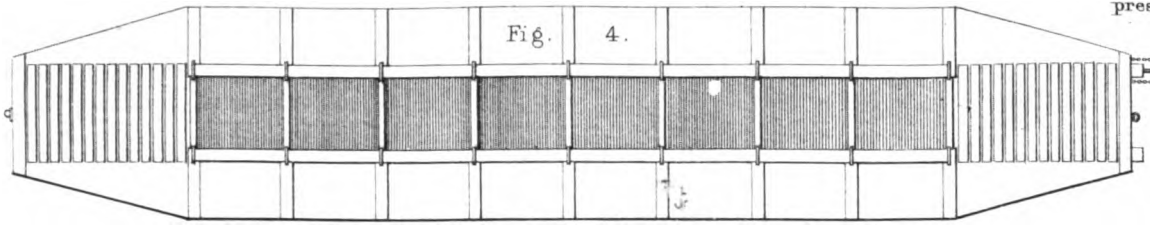
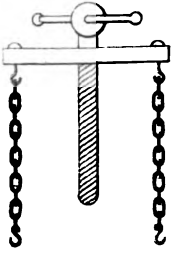


Fig. 4.

Fig. 5.



Screw Jack

Elevation of one frame.

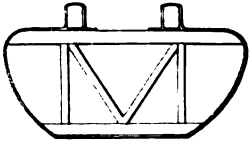


Fig. 6.

Pontoon collapsed.

Fig. 2.

Pontoon with stretchers withdrawn.

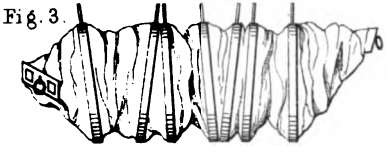
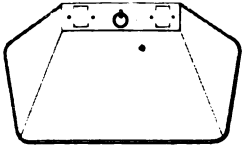


Fig. 3.

End Elevation.



Scale ¼ Inch to a Foot.

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J.R.Jobbins

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has mortices or sockets corresponding to these holes. These are for the reception of the stretchers, which are passed through the holes, and, being run through the iron loops in the top of each frame, are directed into the sockets of the bow-transom, and, being pressed firmly home, stretch the pontoon to its proper shape, in which position the stretchers are keyed through the stern transom. A small screw-jack is provided for each waggon, for the purpose of facilitating the operation of stretching (fig. 5).

As mentioned above, the ends are decked with canvas as far as the first frame, and on these decks are sewn thin ash laths, which are amply sufficient to bear the weight of two or more men for the convenience of anchoring, weighing, &c. (fig. 4).

The body of the pontoon is decked along each side up to the stretcher, the canvas being turned up beside the stretcher and forming a sort of combing to the hatchway; and a contrivance is also introduced by which the hatchway can be battened down so as to form a close vessel in the event of bad weather or being obliged to form a bridge in rough water.

By means of a diaphragm of canvas stretched on each frame, the pontoon is divided into watertight compartments, the two end ones forming air-chambers like those of a life-boat. The stretchers serve also for saddles, the baulks being secured to them by means of perpendicular pins passing through both, the holes in the baulk being enlarged into slots on the lower side, so as to give it play in a vertical direction; the baulks are prevented from rising off their pins by the chesses, which are keyed down at each end to the stretchers (fig. 7), with keys of sufficient length to allow of the vertical play of the baulk. The chesses are laid in the ordinary manner. It is proposed to place the pontoons always at a distance apart of ten feet from centre to centre, no closer order being requisite even for heavy artillery.

The method of forming a bridge is either by rafts or by booming out from the shore, the latter operation only differing from the same manœuvre as at present performed, to suit the difference in superstructure.

In Plate II. fig. 3, is shown the method of packing for transport, where three pontoons with their superstructure are carried on each carriage. The carriage is much shorter than the present one, and will probably be somewhat lighter, as the heavy bolsters are no longer necessary; the wheels are all of equal size, and the same as those of a light 6-pounder, thus giving facility for changing or replacing an injured wheel. The draught is lighter, particularly over rough ground, by the front wheels being made larger, and by the axles being brought closer together; and the carriages is also capable of locking round as easily as that of a field-piece.

Here then we have at once a pontoon similar in form to the best continental patterns, a flat bottom for stability and sides sloping outwards, so that any wash or surge is thrown off, and also that the buoyancy increases rapidly as the pontoon is immersed, while the continental defect of want of deck is also remedied by the canvas deck above described.

If we have not then fallen into the error of the foreign pontoon, viz.: want of portability, we shall have at once a heavy balance of advantages on the side of our canvass boat. Let us then compare the canvas with the metallic pontoons as to their buoyancy, weight, and bulk for travelling;

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and first, as to buoyancy, in Plate IV. figs. 1, 2, and 3, we have immersions of the three pontoons when loaded equally, from which you will see that, while the cylinder is totally *hors de combat*, and the canoe can only just keep its head above water, the canvas boat is riding easily with plenty of buoyancy to spare.

Next, as to weight, we find that the weights of the three pontoons when packed for travelling are as follow: tin cylinder 5 cwt., canoe 8 cwt., canvas 2½ cwt.; and the relative bulk of the three when ready for transport, as given in Plate IV. figs 4, 5, and 6, will show the advantage which the canvas has over either of the others in this most important particular.

It is thus quite clear that the gain over the metallic pontoons in stability, buoyancy, lightness, and portability is very great; and indeed if you will just remember the list of advantages that were claimed for each of those vessels, you will find that there is not a single one in which they are not surpassed by the canvas boat—while the whole of the disadvantages are avoided.

Thus the canvas boat can be bailed out, inspected, and repaired without even withdrawing it from its place in the bridge.

The canvas-boat pontoon is capable of being used and pulled as a boat, and each is perfectly stable by itself; it may be pulled or poled into its place in the bridge without being made into a raft.

The boat is divided into seven watertight compartments, and is thus equal to the cylinder in this respect. A glance at the diagram (Plate IV. fig. 3), will show that the boat will give a higher roadway under heavy loads than the cylinder.

So much for the pontoons individually. The positions which they respectively occupy in the bridge are shown in the diagram (Plate IV. figs. 7, 8, 9), in which a hundred feet in length of heavy artillery bridge are shown as formed of each of the three kinds of pontoon under consideration, the cylinders being placed 8 feet apart from centre to centre, the copper canoe 12 feet 6 inches, and the canvas boats 10 feet apart.

The difference in the buoyancy of the entire bridge may be seen at a glance, the proportions being—

	lbs.
Canoe . . .	70,000
Cylinder . . .	90,000
Canvas . . .	130,000

The method of transport and comparative portability of the three systems of bridge are shown in the Plate II., where we have in the case of the canoe, one two-wheeled cart drawn by two horses carrying 12½ feet of bridge (fig. 1).

With the cylinder a four-wheeled and four-horsed waggon carrying 16 feet of bridge (fig. 2).

And with the canvas boat a smaller four-horse waggon carrying 30 feet of bridge (fig. 3). The horses in the two latter cases drawing

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Equal Weight upon each.

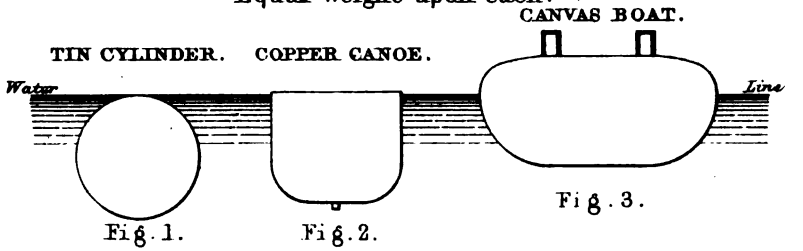


Fig. 1. Fig. 2. Fig. 3.

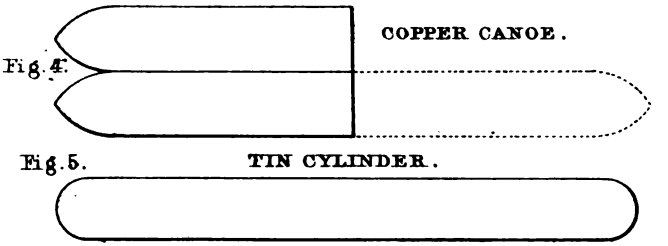
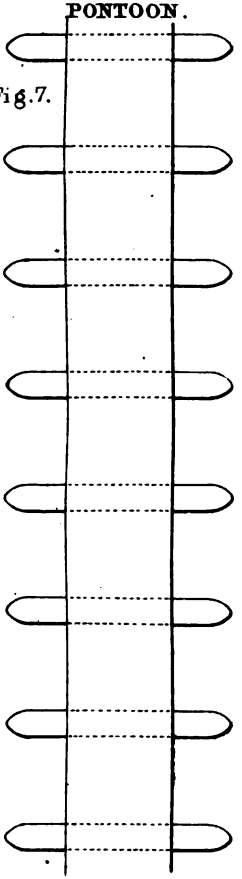


Fig. 6

CANVAS BOAT.

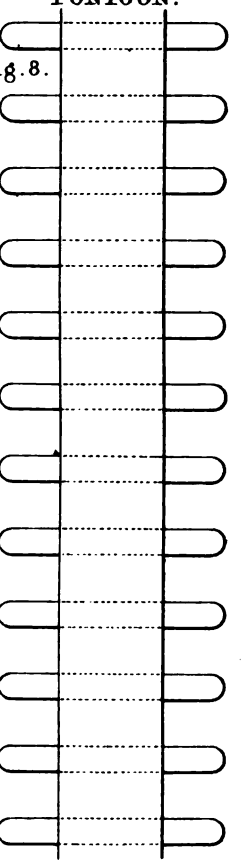
COPPER CANOE PONTOON.

Fig. 7.



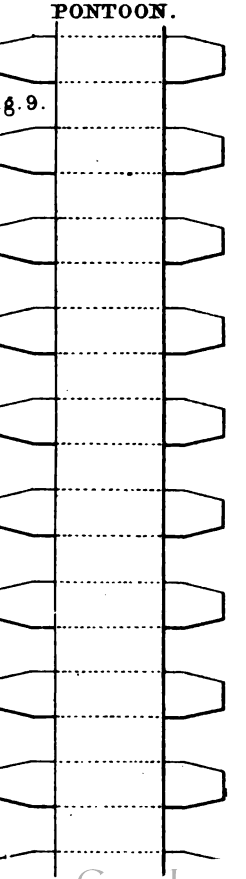
TIN CYLINDER PONTOON.

Fig. 8.



CANVAS BOAT PONTOON.

Fig. 9.



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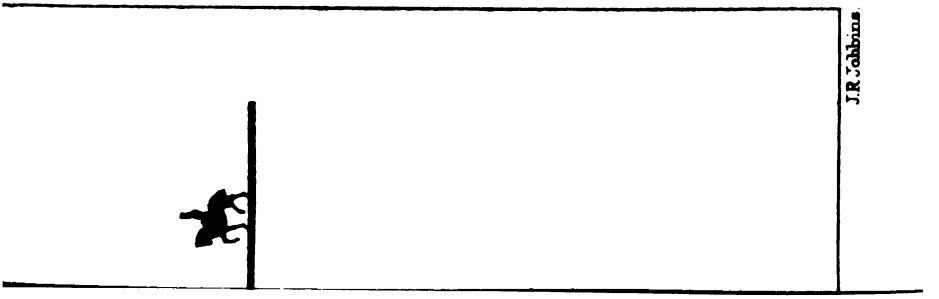

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little more than half a ton each, while with the canoe they are loaded with nearly three-quarters of a ton each, and the wheel-horse has the whole jerk and wear of nearly one and a half tons on his back, which in a rough country it is quite impossible that one horse could bear.

Some idea may be formed of the superior portability of the canvas pontoon bridge from the accompanying diagram (Plate V.), where the quantity of bridge equipment necessary for the passage of a stream 100 feet wide according to each of the systems under consideration is shown on the line of march of an army, and from which it appears that while the cylinder requires six and a quarter waggons, and the canoe eight carts, the canvas-boat bridge is carried on rather more than three four-wheeled waggons.

The line of march is shortened no less than half, which is of itself of great importance, and the number of horses is reduced in the same proportion.

In comparing the three kinds of bridge equipment, I find that there is one point that I had omitted to notice, namely: the difference of superstructure, and here we find that with the tin cylinder four different kinds of pieces are employed.

1. Saddles, being a thing like a ladder.
2. Baulks.
3. Chesses.
4. Outriggers to row with.

The canoe has as many as five pieces.

1. The saddle, which shuts up with a parallel ruler motion very easy to get out of order.
2. The baulk.
3. The chess.
4. The dividers.
5. The outriggers, which are used to row with,

In the canvas-boat bridge we have simply two kinds of pieces in the superstructure.

1. Baulks.
2. Chesses.

The vertical pins of the baulks serving as thole pins for rowing with grummets round the oars.

The superstructure of the bridge is thus simplified to the utmost extent and can in fact be made out of any rough timber with no more tools than a saw and auger.

The canvas pontoon itself could without much difficulty be made in the field, such materials as hoops of casks, canvas, poles, and oil, being almost always procurable.

Of course the first objection that will be made by every one to this pontoon will be that no dependence can be placed in a vessel

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constructed of so frail and flimsy a material, and this has already been made in the extremely favorable official report which I will now read :—

(*Copy.*)

Royal Engineer Establishment, Chatham,
10th August, 1855.

SIR,

With reference to yours of the 9th inst. requesting a reply to the communication of the 21st December, relative to Captain Fowke's canvas boats to be made at Chatham for trial, I have to report, that, after considerable delay on account of the waterproof composition with which they are paid over, they were completed on the 19th July, 1855, and that Captain Fowke came to Chatham on the 31st July to see them put together and launched.

They were folded and carried to the river in a hand-cart, and then distended in about five minutes, and were launched by eight men ; they were then formed into bridge and broken up into raft, and their buoyancy and strength were tested by placing a 32-pounder upon it and increasing it up to 91 cwt. which it sustained perfectly, the gunnels being still ten inches above the water. In one or two places the seams under the great pressure leaked a little, which will probably be completely remedied by another coating of waterproof composition.

In the bridge they were very stiff, and were evidently capable of being formed at a more extended order than the length of baulk Captain Fowke has fixed upon (for the sake of transport) admits of: from the length of bearing of the baulks they are evidently much more buoyant than is necessary, which is proved by the ease with which the raft bore 91 cwt.

Their capabilities of rowing were tested both in raft and as single boats, and it was found impossible to row either of them against the tide,* owing to their extreme lightness and buoyancy, which gave them so little hold upon the water, and it was only by towing them from the shore that the raft could regain the Hard from which they started.

The material with which they are covered is not of a nature to warrant their being placed in a bridge which would be likely to remain any considerable time in the water, but from their compactness in packing and their lightness they might be of great advantage in advanced and desultory operations.

I have, &c.,

Signed, H. SANDHAM,
Col. Royal Engineers.

The Inspector General of Fortifications.

But, before committing ourselves to such an assertion, let us examine this flimsy material, of which I have here a sample, and see if it be *really* so inferior to tin and copper. Suppose we take a square yard of each of these materials and stretch them out, confining them at the edges (and remember that in the square yard they must all have joints, and that in metal joints are a source of weakness, while in canvas they are frequently introduced for the sole purpose of strengthening it). Now if we put a heavy sledge-hammer into a man's hands, and ask him to send it through the three you can in a moment divine the result, the soldered joints of the tin will

* The rowing here alluded to was not only against tide, but against what would almost be called a gale of wind, and at that time no special provision had been made for rowing. An arrangement has now been made, by which the rafts of pontoons have been successfully propelled against a very strong breeze.—F. F.

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be wrenched asunder, the soft copper will be knocked into a hole, but the yielding and elastic canvas would defy the efforts of any one to injure it. But you will say it is not so much a blow as the effect of friction or chafing that you have to dread for the canvas—true; but to render the chafing most effectual it is necessary that the canvas should be supported at one side and rubbed or bruised at the other. Now if you examine the frame of this pontoon you will see that this is guarded against, and that in every place where the canvas is in contact with the frame on one side, it is invariably covered by a protecting hoop on the other.

You will observe also that, along the sides where there is the greatest likelihood of injury from collision, the frame is as elastic as a carriage-spring, it is in fact its own buffer, the stiffness and strength of the skeleton being gained in the interior, where the weight of the bridge is borne, directly by well-framed tressles which are perfectly sheltered from all chance of injury.

An attempt has been made to remedy the want of portability of pontoons by substituting an india-rubber inflated bag, which was employed with considerable success in some minor operations at the Cape in 1848; its advantages are lightness and portability, but I think it will not be difficult to shew that, while the canvas pontoon is superior to the india-rubber one in other respects, it also far surpasses it in those very qualities for which the latter has received so much praise from its numerous admirers.

First take the weight of the two pontoons when packed for transport:

India-rubber,* 413 lbs. Canvas, 260 lbs.

Second, the bulk of the two pontoons when packed for transport—in cubic feet:

India-rubber, 17½ cubic feet. Canvas, 15½ cubic feet.

Third, the ultimate buoyancy of the pontoons—in pounds:

India-rubber, 8,127 lbs. Canvas, 10,974 lbs.

From this comparison it would seem that in these particulars in which the india-rubber pontoon is superior to the present one it is surpassed by the canvas one; besides which, the latter is free from many of the defects to which the india-rubber is liable. Thus the india-rubber is so delicate as to require to be packed in a case. The slightest puncture is fatal to it, which, in the case of the canvas, would only cause an inconsiderable leak. It has to be kept air-tight instead of merely water-tight. It is dependent on its inflation by air for its form, consequently on receiving the smallest wound either above or below water, it will collapse.

There will always be a considerable delay inunpacking and inflating. The india-rubber is much affected by temperature, becoming almost unmanageable from extreme cold, and after exposure for any length of time it loses all the properties of india-rubber, and becomes extremely weak and easily torn and broken.

* The india-rubber pontoon weighs 260lbs, and its packing-case 153lbs.—Total 413lbs. —F. F.

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The cost is not stated in the description of this pontoon, but, judging from that of india-rubber goods generally, it cannot, if well made, be much less than four or five times that of the canvas one.

Of the many varieties of pontoons which have at different times been brought forward it will not be necessary to speak in this paper, the merits and demerits of all of them having been so frequently discussed in relation to the present service pontoon, which has here been taken as the standard of comparison.

We have seen, as you may remember, that the Russians have a pontoon of waterproof canvas. They first used it in 1807 when they successfully made several passages of rivers with it; they still employ this pontoon, and I have a letter from a distinguished officer, who has seen and studied much of foreign armies, in which he says, "The Russians have a canvas pontoon which they are very fond of." So, as it has stood the test of more than half a century's experience, it would appear that, after all, there may be something in this flimsy material.

I may give another instance of the employment of canvas as a boat covering. On our wildest and most unsheltered coast, exposed to the full swell of the Atlantic, the Galway fishermen are in the habit of going out long distances to sea in their long row-boats, which are formed of a skeleton of wood covered with either canvas or hides, and they hold the opinion that such a boat is more seaworthy than a wooden one, from the fact of its elasticity in a rough sea.

Sir Howard Douglas mentions that, in India, boats for military purposes have been successfully constructed of hides stretched over a framework of bamboos, and strongly advocates the employment of basket-boats for such purposes.

I may be perhaps allowed to give my personal experience with canvas boats. I have at different times possessed three canvas boats, all of which I constructed myself, and I can safely say that I have often exposed them to injury by running on rocks and piles which would have been fatal to a wooden boat, and that I never met with the slightest accident in one of them.

I am sure that the idea of canvas being more liable to injury is a most mistaken one, but if injured it is infinitely more easily repaired. If a tin pontoon spring a leak you are only made sensible of the fact by finding it gradually disappearing from under you; you have no means of knowing the position or character of the injury, and the only thing you can do is to break the bridge, thus stopping all communication, get the pontoon (which must be lashed to its fellow) to shore, light a fire and set a tinker or two at work, who will probably make a day's job of it; while with the canvas boat you can constantly inspect the interior, and in case of a leak you have only to send a man in to find out its situation, when a little pitch-plaster will remedy it *pro tem.*, and the regimental tailor will set it to rights in ten minutes on the first opportunity.

The lightness of the canvas pontoon would moreover admit of a complete extra set of pontoons being carried without even then bringing up the number of waggons to that necessary for the transport of either of the others, and thus you could afford to have one relief of pontoons always

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in hospital, and another fit for duty; and, as a canvas pontoon is not half the cost of one of the others, there could be no objection on that score.

I know that it will be urged by some of the admirers of the metallic pontoon that the canvas boat will not row so well as either the tin or the canoe, to this I would answer that there is no difficulty in making a perfectly good and fast boat with canvas, but at present our business is with pontoons; if we try to make one thing do the work of two, we shall probably arrive at the usual result of such contrivances, viz.: that it will do neither well, and the end will be that we shall spoil a good pontoon to make a bad boat.

It seems to be doubtful whether the quality of rowing has not been for some time very much over-rated in value in our pontoon service; at Chatham it certainly has its advantages in providing healthy exercise for the men and producing a pleasing effect on a field-day, and its value is perhaps greater in home campaigns than in actual warfare. In order, however, that the canvas boat bridge should be efficient in this respect also, I propose that for every five waggons of bridge there should follow one boat-carriage which would carry five boats of this model, viz.: a whale boat 34 feet long by 6 feet beam, pulling twelve oars, with water-tight bulk-heads up to the thwarts, and with an air vessel at each end, capable of sustaining fifteen or twenty men in case of accident to the boat. Thus to every three pontoons there would be one full-sized ship's life-boat which could live in almost any weather, which in case of emergency could supply the space of a spare pontoon to the bridge, and which would not only free the canvas pontoon bridge from the charge of want of power of locomotion, but would place it in this particular far beyond any former pontoon bridge that has ever been constructed.

If then, as I hope, I have been able to shew that we have the power of constructing a pontoon that shall be so superior to that now in use in our service, that

1. Its buoyancy is nearly double;
2. Its weight little more than half;
3. Its bulk for transport only a seventh;
4. Its superstructure greatly simplified;
5. The length of its bridge on the line of march less than half;
6. The number of horses reduced in like proportion;
7. That it is accompanied by a life-boat to every three pontoons;
8. That the cost is reduced considerably;

and if with all these advantages we have likewise succeeded in retaining the almost perfect stability and bridge-forming qualities of the *bateau à ponton*, I think we may fairly be said to have made an attempt in advance towards the perfect pontoon equipment which is sighed for by the writer in the *Aide Mémoire* above alluded to.

I shall conclude by telling you that the War Department have appropriated a sum of money for the trial, on a considerable scale, of the canvas pontoon, that several of them are now being constructed under my super-

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intendence, and that before the summer practice is over I am in hopes that we shall be able to report some progress towards the attainment of this military philosophers' stone, a perfect pontoon bridge equipment.*

* The pontoons here alluded to have now been constructed; and in a trial which took place in presence of H.R.H. the Commander-in-Chief, both pontoons and life-boat have fully come up to the estimate that is here made of their powers, both as to portability, buoyancy, steadiness, and stability when in a bridge.—F. F.

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Friday, May 11th, 1860.

General Sir J. F. BURGOYNE, Bart. R.E. G.C.B. in the Chair.

THE DEFENCES OF PORTSMOUTH.*

By COLONEL SHAFTO ADAIR, F.R.S.

A.D.C. to the Queen.

THERE are special difficulties incident to the treatment of strategic questions as applicable to England, arising from the character of her people, and from the character of her wars. The English mind has great difficulty in admitting the assumption that battles might be fought in the course of events on English ground, although forts and works of defence indicate such a possibility. Secondly, in the interval between the Peninsular War and the first Scinde Campaign, though England was rarely at peace, no war of strategy was undertaken. Probably the largest school of experience is to be found in the operations consequent on the Indian Mutiny. The system of concentration of columns on the positions of the mutineers, in order to crush the rebel forces after the capture of Lucknow, is a magnificent object of study.

Rationale of Defence.

There are five principal points to be considered—

First. Whether any and what portion of the national defence shall be assigned to fortresses or permanent works of the first class.

Secondly. Whether these works shall be treated as substantive and isolated points of resistance, or as points of appui in strategic plans and for tactical movements.

Thirdly. Whether the regular Army is competent in numerical strength to the service required.

Fourthly. Whether the Militia, that is, the Army of Reserve, the Yeomanry, and Pensioners, can be made available. And

Fifthly. Whether the defensive system can be so composed as to include the service of a volunteer auxiliary force—Infantry, Cavalry, Artillery with Engineers, and Boat squadrons.

Let it, then, be assumed that England must have a special military system for home defence. And in this should be utilized the sedentary

* The district map referred to in the Lecture has not been published, to avoid great increase to the size of the publication, but it is hoped that the details given in the Appendix will enable the reader to follow the plan.

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portion of the national forces. And, to suit the defensive character of her strategy, as well as to compensate for paucity of numbers and lack of practical experience, the system must be largely based on the advantages to be derived from fortified positions, whether permanent or field. Hence it may be assumed that the defence of fortresses of the first class must be entrusted to the regular forces, and that of the field works to those of the second class—to the Army of Reserve and the local forces.

Now as regards the nature of English works of the last 150 years—from the time when the feudal castle or military blockhouse of Henry VIII.'s construction became obsolete—the most noteworthy quality is the low power of defence, combined with large capacity for garrison and stores. As at Landguard Fort, every work had the pretensions of a fort; and every fortified town, of a fortress, as on the lines of Portsmouth. The model afforded by the bastioned villages of the Flemish frontiers was faithfully copied by the Engineers who had been present at the sieges of the wars of William and of Marlborough. But the English defensive work, redoubts, forts, or fortress, should represent the keep of a camp of manœuvre.

I proceed, with the sanction of H.R.H. the General Commanding-in-Chief, and the permission of the COUNCIL, to consider the conditions under which the defence of Portsmouth may be conducted, either as the site of an arsenal and dockyard, as a maritime fortress, or as a land fortress of the first class, with its dependent positions and entrenched camp; and also as furnishing a base of operations in the event of invasion. I propose, however, to omit all means of defence depending on the Naval departments in activity.

First. With regard to Portsmouth as the site of an arsenal and dockyard.

On referring to the map it will be seen that if a line be drawn from Fort Monckton, at the western angle of the outer harbour, or roadstead, to Southsea Castle on the eastern, as a base, and thence, on either shore, to the Block House Fort, the point where the gorge narrows and the harbour is entered, as the apex, an isosceles triangle will be described, of which the sea-base = 3,500 yards, and the sides = 2,300. Outside, and almost parallel with the base of this triangle, the fair way lies from the westward, till arriving at a point nearly opposite Southsea Castle it joins the passage by the Nab Light, from the eastward, which forms an obtuse angle with the direct passage into the inner harbour, passing under the sea-face of the lines of Portsmouth proper. This triangle lies in-shore of one of the chief anchorages of the empire; wherefore great care has been taken, at all periods, from the time of Edward VI., to secure the anchorage from occupation, and the sea-face of the works from close attack. Now, although it would appear on the first inspection easy to make the inner harbour at any time of tide, yet the channel is tortuous and exceedingly difficult of entrance and exit at times, and always inaccessible to heavy vessels with their lower deck guns in. With regard to the protection which is given by landworks, two forts at the gorge, namely, the Block House Fort and the Point Battery, project their fire athwart the channel. Fort Monckton with its guns sweeps the anchorage at Spithead, and Southsea Castle brings to bear a diverging

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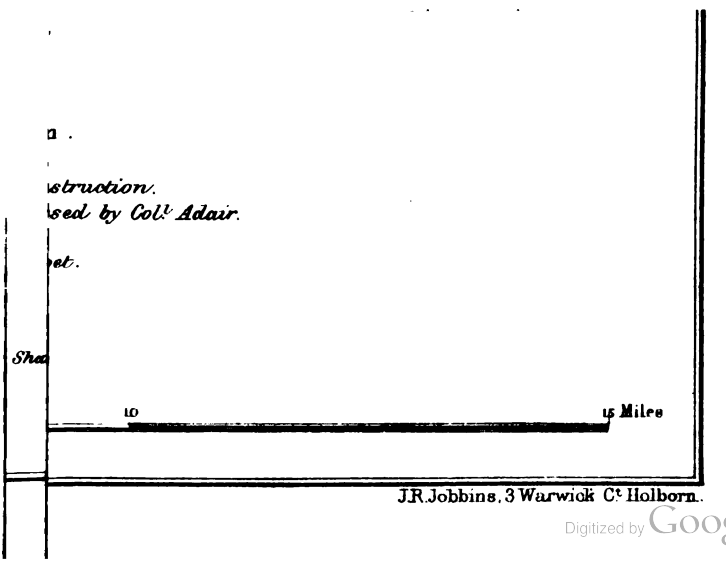

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fire on the eastern and western passage, which unite at 1,200 yards from its batteries.

It is needless to detail the nature of the armament of these works. Southsea Castle is a work of an old trace, like the forts within the limit of the Cinque Ports. These have been enlarged and strengthened so as best to meet the requirements of warfare, and may be described as being constructed on the same principle as the original works which were enlarged and re-modelled by Vauban and his immediate successors, and not on the pure bastioned trace, or on the polygonal, which obtains so prominently at the present day. The fire of these works sweeps the channel very effectually. Southsea Castle gives an oblique fire on vessels approaching and passing into the inner harbour, but it has been found necessary to supplement its fire by reconstruction of a work on the foundations of the old Lumps Fort, 1,600 yards to the eastward. This work is on the new construction, and will mount 17 heavy guns, sweeping by direct and oblique fire the obtuse angle down which vessels coming from the eastward pass into the inshore channel parallel to the coast line. A similar work is projected between Lumps Fort and Fort Cumberland. The fire from the old works on a bastion trace at Portsmouth is simply perpendicular to the line of passage, and not apparently very effective against steamers; while to judge from the construction, the nature, and command of these works in reference to the immense offensive powers of vessels of war with the present armament, it appears probable that any heavy vessel, well within range of the King's bastion, and the curtain connecting it with the Point Battery, would act with most destructive effect against that portion of the sea line of defence. But a vessel approaching for that purpose, being broadside to the main works of Portsmouth, would, having endured the oblique fire of Southsea Castle and Lumps Fort, be raked by the guns of the Block House Fort, and therein consists the safety of the Channel. It appears then that, so far as direct fire will prevent the ingress of vessels of war, the key of Portsmouth Harbour lies in the Block House Fort.

The question of the shape of embrasure, and of the protection enjoyed by plated vessels, will be considered hereafter.

Now, restricted as every heavy vessel of war must be in the choice of the channel, and exposed during the greater part of her course to a heavy and fatal fire from Block House Fort, it is not very probable that it would be attempted to force the passage of the inner harbour by the unassisted broadsides of line-of-battle ships or heavy frigates. I leave the question of the accuracy with which guns can be trained from the decks of vessels under steam, so perfectly manageable as they must be, to professional discussion. But one point should be noticed which has not yet been brought prominently forward in respect to the defences of Portsmouth Harbour. The approach of vessels of war, of the heaviest class, is restricted by the circumstances of the tortuous channel delaying their course, while their huge bulk is exposed to the fire of the forts. But there is another element of attack which might be developed in aid, and would exercise a very material effect on the fortunes of the day: I speak of those formidable and minute batteries of movement, gun-boats. I class among gun-boats every steamer that is

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restricted to the use of one or two guns. With the experience of the last war to guide us, it is probable that in any attack on Portsmouth, not made solely for purposes of destruction by vertical fire from long ranges, gun-boats would be brought up, and materially assist, in accordance with the system of nautical tactics, which in many cases prefers the fire of accumulated gun-boats to the heavy battery of a man-of-war. Now, a gun-boat engages a battery ordinarily at great advantage. If the Block House Fort or Point Battery be attacked, on the prolongation of the capital, that is, perpendicular to the face of the work, the loss caused by enfilade is reduced to the lowest expression, especially if the rear of the guns be secured by parados, or by ramps perpendicular to the rampart, as on the Gomer-Elson lines. But if a gun-boat be placed permanently upon, or occupy at intervals, a point in enfilade of a heavy shore battery, the conditions of the contest become most unequal. The gun-boat, with its power of movement, small bulk, and heavy armament, selects a position whence it can by projection of shells to the rear of the work distract the attention and annoy the gunners of any battery not entirely casemated. For in the case where the gun-boats' line of fire traces a very obtuse angle to the face of the work, the Haxo casemate would in itself be but slight protection against the scourging and searching fire from shell guns plunging in reverse. A floating shore-battery might take up the defence doubtless, but would in turn be shelled by another gun-boat, and a series of duels would result of giant against dwarf, where the chances were in favour of the party whose defeat or annihilation would probably be no equivalent for the loss previously sustained by the battery. Let it be supposed that a line of gun-boats is echeloned in shoal water in a line parallel to the faces of Fort Monckton, the Gillkicker Battery, and Blockhouse Fort. A more formidable line of battle in aid of an attempt to force the in-shore channel can scarcely be devised. And let the same conditions be applied in diversion on the eastern passage, from Fort Cumberland to the entrance of the in-shore channel. It may be assumed that this fire of support would be sufficiently destructive. It must be dealt with and dissipated on tactical principles, identical with those which define its adoption. The ascendancy acquired to the maritime attack by dissemination of fire over land defence must be reversed, and the superiority restored to batteries over the formidable gun-boat. But provision has not yet been made in the sea defences of Portsmouth to meet this contingency. It has been laid down by high authority, that under circumstances similar to those under which the attack of Portsmouth Harbour would be conducted, a supplemental fire on heavy vessels should be disseminated, because, in proportion to the dissemination of fire, loss is occasioned to the antagonist, whose fire is massed.

A very remarkable action might be quoted, which was fought in the Scheldt in 1814, with one 5½-inch howitzer and a field gun against the battery of a French frigate. The howitzer and field gun were placed in position on the banks, and the French frigate, lying in the channel, was ultimately obliged to weigh. This illustrates the advantage of a disseminated fire. It becomes a question, then, how far the direct fire of the heavy forts shall be supplemented by scattered batteries specially designed to act against gun-boats.

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It may be well imagined that in the triangle, including the Spitsand, and in shoal water of 1½ fathoms, it would be perfectly easy for a detachment of gun-boats so to take up their position that they would harass, and possibly even keep down, the fire of heavy guns mounted in works of rectilinear trace, while those very guns could not be brought to bear on the gun-boats. Now what is true of disseminated fire against batteries from the sea, is true of disseminated fire against gun-boats from the land. It is proposed then to construct a system of batteries as against gun-boat attack especially, but also to serve against heavy vessels. The conditions of construction of such lines are easily determined by the positions which lines of gun-boats would of necessity occupy for the purpose of co-operating in a maritime attack. Let a line be drawn from Southsea Castle at an obtuse angle to the salient of the King's Bastion, a distance line of 1,430 yards to the westward; and to the eastward draw a line passing through Lumps Fort at 1,600 yards, to Fort Cumberland, a further distance of 2,800 yards. Now it will not be sufficient to have a disposable force the specific duty of which shall be to engage a gunboat squadron, but it must also be so disposed as to overpower the gun-boat fire without accumulating such a mass of gunners and artillery within works under fire from the gun-boats, which would be murderous in its effects proportionately to the number of men and guns. Southsea Castle is supported on either point by two auxiliary batteries, having a flanking fire eastward and westward of two 68-pounder guns.

On these lines it is proposed to construct, at such a distance from the crest of the beach as should give sufficient command of the in-shore channel, and commencing on Southsea Common, a line of 3-gun batteries *en echélon;* these guns would be scarcely seen over the beach, while they would exercise a perturbing influence over the movements of the gun-boats. Three guns are assigned because the concentrated fire of three guns on a single gun-boat would probably occasion her to alter her position if stationary, or disorganise, if in motion, the system of delivering fire on recurring curves of approach and retreat. The fire of Southsea Castle might be advantageously delivered gun by gun. On the prolongation of the line towards Lumps Fort, and thence to Fort Cumberland, at suitable intervals, and at such an elevation as should give due command, batteries should be half sunken, constructed on the same principle, so that even if a line-of-battle ship worked into the channel, the probability is that but very slight harm would be done to the disseminated batteries.

It is with very considerable diffidence that I venture to make these suggestions, yet it has struck me forcibly, in the course of practice from the batteries of Southsea Castle, due regard being had to the peculiar nature of the entrance to the inner harbour, that it will be necessary to prepare some special system of defence against the class of attack by gun-boats, which would be very irritating, and might, possibly, become dangerous; and is, moreover, a system the materials of which lie within the capacity of non-maritime states, or maritime states of the second order, to organise at no great cost of money, men, or sea-going experience. A partial idea of the tactics applicable to an attack of this class may be easily obtained. The chart printed on the occasion of the Great Naval Review of 1856 represents the primary or original position of the men-

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of-war, gun-boats, mortar-boats, and floating batteries, which were reviewed by Her Majesty at the termination of the Russian war. Those present will remember how triumphantly those magnificent 24 sail of the line swept the sea at Spithead without a sail being let fall. And they will also recollect the general effect of energy and concentration produced even by the blank firing in bombardment of Fort Monckton, from the mosquito fleet of gun-boats which anchored in shore. The positions pointed out in the chart give a very instructive lesson on the probable course of attack by heavy vessels, whether alone or assisted by mortar and gun-boats and floating batteries.

In considering the attack by direct fire, as on the Block House Fort, the question of construction of the embrasures of all works, especially of the casemated, becomes of importance. The engineers of the United Service have given much attention to this subject, with reference to their coast defences, and from the experiments recorded in the Report of Brev. Brig. Gen. Totten, on the effect of firing against embrasures, 1852, 1853, and 1855, it appears that by the employment of embrasures with offseted cheeks, as compared with embrasures with flaring cheeks, the conditions of entry of canister iron balls 1·05 are reversed. Thus—

Of canister iron balls . . . 1·05 diameter, per cent. fired
Against Embrasures with flaring cheeks 95 reflected, 5 stopped.
" " Offseted cheeks 6 reflected, 94 stopped.

The materials for construction in order of excellence are stated to be—wrought iron, lead, concrete, brickwork, sandstone, granite. But the tabulated results, p. 160 of the Report, are more remarkable as between ships and forts :—

TABULATED RESULTS.

Iron and leaden canister balls discharged in half an hour through embrasures of a casemated battery of twenty-four guns, and through port holes of a ship of fifty guns in each broadside, total surface fort and ship each = 6,000 square feet. In 32-pounders and 8-inch guns. Number entering each embrasure and port hole.

	No. entering each Embrasure.		No. entering all the Embrasures.		No. entering each Port.		No. entering all Ports.	
	Musket	Iron 1·05	Musket	Iron 1·05	M.	I.	M.	I.
From 32-pounders :—								
Large embrasures, 54ft. -	1,404	351	33,696	8,424				
Target embra. flaring cheeks	231	58	5,544	1,392				
——— offseted cheeks - -	101	25	2,424	600				
——— shutters - - -	10	3	240	72				
SHIP'S PORTHOLES	—	—	—	—	126	31	6,300	1,550
From 8-inch guns :—								
Large embrasure, 54ft. -	2,754	648	60,096	15,552				
Target embra. flaring cheeks	453	106	10,872	2,544				
——— offseted cheeks - -	198	46	4,752	1,104				
——— Shutters - - -	20	5	480	120				
SHIP'S PORTHOLES	—	—	—	—	252	52	12,600	2,600

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The paper is to be found in Prof. Papers, R.E., which should be consulted on construction of offseted cheeks and of embrasure shutters.

With regard to the armament of the sea-faces of these batteries and of the works, the general employment of shell-guns should be insisted on; mortar fire is inefficient against shipping. The result of experiment from a 13-inch mortar at a range of 600 yards, against an anchored steamer whose beam shall be 40 feet, gives a per-centage of 16 hits. But there is another weapon, namely, the shell-gun, from which can be projected into the advancing vessel, a missile of sufficiently disruptive force, with much greater certainty of aim. And as to the result of the explosion of a shell on board a man-of-war, that remarkable instance of the explosion of a shell in the Medea, printed in Sir Howard Douglas's "Naval Gunnery," shows that the explosion of several shells must produce a most terrific effect on the strongest vessel. But it must be understood that the shell guns are to project shells, or red-hot shot, and not cold hollow shot, which is a projectile of the least satisfactory results of its class, fired from batteries against shipping.

Many interesting points of detail, as for instance the merits of the Armstrong and Whitworth guns, and of the resistance which plated vessels may be able to oppose to batteries, must necessarily be postponed. But it may be observed here, that the advantage derivable from the projectile will be multiplied and increased by successive trials, and it is probable that whatever resistance the strengthening of vessels may have given under the old system, will be still further increased by the powers of resistance given to plated vessels.

Still it is said that the Whitworth 8½-pounder gun has pierced a wrought-iron plate of 4·5 inches at 200 yards. But the experiment was probably made against a stationary object (the floating battery), and on a line of fire perpendicular to the vertical plane of the target.

Is it to be assumed that the penetration would have been equal against an object in motion, whereof the point of percussion should lie in a plane inclined to the line of fire at an angle of not more than 15°? If not, then every gun commanding the channel of approach to a harbour must be capable of traversing at low horizontal angles, and in fact become a gun of *enfilade*, and, if not *en barbette*, the cheeks of the embrasure should be splayed proportionally.

But one disturbing element of calculation in the trace of sea works has already shown itself. The increased range of the Enfield rifle has extended the line of defence from 180 to 500 yards, as in the sea rampart and works at Alverstoke, that is as 3 to 1.

Passing from the attack to force the passage of the inner harbour, the consideration of Portsmouth as a maritime fortress is now to be approached. And here it becomes incumbent to refer to an omission which, no doubt, has already been noticed, namely, of notice of the defences of the Isle of Wight. Considering Portsmouth as a maritime fortress, the Isle of Wight must be taken as a work projected across the main ditch, or as an outpost to be most vigilantly guarded. I prefer assigning the tier-towers which have been suggested, and will be probably carried out on the Horse Sand and on No-Man's Land, to the defence of the passage of the eastward of the Isle of Wight, rather than to take them

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into consideration of the defence of the harbour proper. The works then that are now available for the defence of the passage to the westward are, Victoria Fort, the Cliff-End Fort, and the batteries at Hurst Castle to the westward. On the south coast lie the batteries of Freshwater and the old work of Sandown, which though now valueless from decay, is well placed for sweeping the coast. I would here refer to the ingenious system of an anonymous writer who proposes for the defence of the coast line of England works which are thus described.

Vessels carrying batteries of heavy guns capable of injuring forts can nowhere approach within a considerable distance of the shore—this distance being generally greater where the nature of the coast affords, in other respects, fewer advantages for defence, and more facilities for invasion.

If the space near the shore within which ships and floating batteries cannot be brought, and which an invading army must cross in open boats, and if the beach and banks upon which it must land and form, be effectually under the fire of a sufficient number of guns, it will be impossible for a force, however numerous, to land its artillery and ammunition, except it can first silence the fire of these guns.

But because ships cannot approach close to the land, it is possible to plant guns protected from their fire that will accomplish the purpose.

Where the line of the coast has bold curves or projections, and the banks are elevated, such positions will, for the most part, be readily obtained, and require little aid from art to render them efficient for protection; but where such natural advantages are not to be found, earth mounds of adequate dimensions will do all that is required.

If small forts, protected either by the form of the coast, or by artificial earthworks, from fire from the sea (except that which is from too great a distance to injure them), made bomb proof and secure from escalade, be placed along the shore at proper intervals and positions, the fire from them will command every point on the shore, and the approach to it in such a manner as to render a hostile landing impracticable.

A bank of earth 150 yards long, placed along the beach close to high-water mark, sloping upon its sea face, and supported by a nearly vertical wall upon the land side, made of sufficient height and thickness, will protect guns placed near the centre of its length, pointed along the shore, from being fired upon from vessels, except from a very great distance. For instance, a gun placed 15 yards behind the embankment, is only exposed to a vessel that approaches within 400 yards of the shore at 2,100 yards distance; one placed 9 yards away from the mound does not become visible till a vessel as near the shore is 3,500 yards off; while one only 3 yards from the wall cannot be seen from a nearer point than 7,000 yards, and that only by a vessel within 250 yards of the land.

By making the bank sufficiently high, several tiers of guns may be placed in such a position, so that an adequate fire can be maintained in both directions along the beach. The shot from the guns three, nine, fifteen, yards respectively from the mound will strike the water's edge about 300, 500, and 1,100 yards from the guns.

It must be evident to every one at all aware of the effect of artillery, that such a raking fire *along the beach* as these guns could maintain would make it altogether an impossibility to land guns and ammunition either by day or night, in thick weather or in clear, by the most sudden surprise or the most extensive preparation; and that, to prevent artillery being brought on shore is all that is necessary to deprive invasion of any terror.

The cost of a bank of earth to protect a fort of three tiers mounting eighteen guns, need not exceed £2,000.

The cost of the fort itself, bomb-proof, surrounded by a ditch, protected by a gallery with loopholes for musketry in the wall of the earthwork, need not exceed £3,000.

The available range of rifled cannon, when used as these would be, may be assumed as extending at least to 9,000 yards (above five miles), so that a system of such forts placed at intervals along the beach, varying according to the nature of the coast line, of from two to seven miles, and flanked by similar forts, similarly protected, placed in the intervals between them, upon or near to the line of the cliff or bank, will effectually secure every point of the coast.

The cliff forts will protect the faces of the embankments in front of the beach forts and the parts of the shore not reached by their guns: also they will command the line of the cliff and the country inland to a considerable extent.

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This system is not likely to require upon an average more than one fort for every two miles of coast, so that the cost need not exceed £2,500 per mile.

There is no form of coast line or kind of shore to which this species of defence is not adapted, the principle remaining the same, though the details would vary—it would be impossible to find any point upon the coast where a gun can be put on shore that may not be placed under the fire of a battery screened completely from being injured by fire from the sea.

This system appears to be specially applicable to works constructed in the bights of a bay, or on a projecting headland. A work to command Brading Harbour, and the anchorage of St. Helen's completes the land defence of the island to the eastward. And the sea-line will be closed by the two-tier towers hereafter to be placed on the firm ground of No-Man's Land and the Horse Sand. The question of forcing the passage of the Solent from the seaward has been often discussed, but chiefly with reference to the nature of the work at Cliff End, and its capabilities for a satisfactory defence. It was asserted that the heavy guns of this casemated fort could not be worked on account of the retention of smoke from the casemate construction, or that, if the guns could be continuously worked, the heavy firing would bring down the walls. When the Commission of National Defence inspected this fort, all the heavy guns were fired with 20 rounds each, and, while no wall of construction in the whole of that fort was shaken by that heavy firing, the guns were worked with the most perfect freedom from suffocation; and this is very remarkable, for the air was very still and the smoke almost motionless; the only difficulty was that the smoke, being, from the peculiar formation of the adjacent coast, completely shut in from the influence of wind from every quarter but to the direct front, hung before the works; a certain disadvantage, unless there was some current to sweep it away, but one equally affecting an open work. But even this disadvantage might be minimized by firing guns alternately, or at intervals, so that the smoke would lift by the concussion, and thus a constant fire be kept up upon passing vessels.

The batteries of Hurst Castle and its dependencies have been strengthened and enlarged, and under their slopes an experiment was tried very satisfactory to the position of troops lining a beach against disembarkation. It was doubted whether round shot in striking the beach would not produce, by displacement of pebbles, an effect analogous to that of shrapnel. Several round shot were fired from a gun-boat, against a target formed from sail. The shot struck at some 30 yards from the sail, and after a very careful examination not half a dozen pebbles were projected forwards to strike the sail. A portion of the crest of the beach had been swept bare by the round shot, but the shot deflected the pebbles upwards, and, consequently, riflemen might have been lying below the crest of the beach without any risk of being dislodged or wounded by pebble showers driven in upon them.

With regard to the defence of the Isle of Wight by troops, the opinion of a distinguished officer, Colonel Hall, of the Durham Artillery, is here by permission made public. "It appears to me that, supposing our fleet eluded or scattered after naval engagement, an enemy might land in Alum Bay with little difficulty; prepare a gun road to the high ground; seize Cliff-End earthwork, and taking in reverse Cliff-End and Victoria

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Forts, command for a time the western approach to our great naval depôt at Portsmouth. From thence, proceeding north-east by Cowes, take Osborne, which would be occupied as a Quartier-Général. From Ryde, Spithead would be commanded, and even the dockyard at Portsmouth might be set on fire by rifled artillery. To meet such a force, *selon les règles*, 10,000 men would be required, of whom 600 should be trained field artillery men, with 490 militia or garrison artillery in the works of Fort Victoria, Cliff-End, Yarmouth Castle, Freshwater, and Sandown Redoubt. Two heavy batteries of movement, one nine-pounder battery, and a half troop of horse artillery, would give three field pieces per 1,000 bayonets nearly. Three hundred of the engineer corps would at least be required, considering the skilled labour necessary for the repair of the masonry, and iron racers of the armament. Deducting 200 for cavalry, leaves 8,400 infantry. The force to be encamped and entrenched would then amount to about 7,840." He then proceeds to suggest that a camp for 2,500 men should be formed between the village of Freshwater and Cliff End, leaving 5,250 to occupy the central and important position on the hill, which should be entrenched, to the eastward of Carisbrook Castle. "If, however, a battery of four 32-pounders (or heavier if completed) of the new rifled ordnance can be supplied and placed in position on a point a little to the north-west of the old lighthouse above Scratchell's Bay, the force above calculated might be reduced to at least one-third of the number. The soil here is good, unlike the unmanageable clay at Cliff End, and in this elevated position an earth battery, with embrasures protected from ships' musketry by mantelets, would suffice without multiplying the permanent works on the island. If such battery were well manned and officered, no vessel or boat even could pass, by day or night, through the narrow channel between the Needle rocks and shoal." These opinions show, first, what positive advantage and efficiency may be anticipated from rifled ordnance; and, secondly, how materially the great difficulty of getting a sufficient number of men for defensive operations would be obviated. This question, now so largely discussed and with such energy, is by no means new in the records of our country. A reference will be found in the "Sussex Archæologist," to councils held by Queen Elizabeth in the year 1589. To these councils were summoned her generals and statesmen, and their words and their warnings are applicable now. For instance, there is a general consent amongst those consulted that some fortification should be erected at Hurst; and over against Hurst, in the Ordnance map, will be seen marked "Cary's Sconce," "sconce" being then a term for "redoubt," and this, doubtless, was the *scondito* of the Italian engineers, and a work then projected under the auspices of that great soldier.

Lord Essex, advises, "that a great fort should be raised over against Hurst Castle." Lord Burghley suggests "that Portsmouth should have a sufficient garrison; and also that the Isle of Wight, with 900 men, could stay the possession of an enemy, as was proved in the last year of Henry VIII. when all the French navy was at St. Helen's, and their forces were repulsed by land by the forces of the Isle, with the aid of the two bands of Sir Francis Knollys and Sir Richard Bland. It is not probable," he says, "that Southampton would be attacked unless Portsmouth and the Isle of Wight should be attacked, but there he would suggest also

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that some sconces or ravelins of earth should be made." Now this is the first time that ravelins are mentioned as a single or independent work. Much stress is laid on arms and training, and, with a true perception of the principles of defensive warfare, on breaking up of the country, and defence of positions. Sir Francis Knollys says:—"There must be men, and store of pioneers, but, if time permit, Plymouth, some place in the Isle of Wight, Southampton, Dover, Rye, and some places in the Thames, should be fortified." And thus speaks Carew, the Lieutenant of the Ordnance:—"The Isle of Wight is most needful to be respected. Portland, an island strong by nature, which by a help of a little would be made impregnable, if once gotten by the enemy, would give command and annoy us." Thus spoke the wisdom of our ancestors.

Passing to the consideration of the land defences of Portsmouth, I must ask those who have honoured us with their presence, to accompany me, as it were, to the crest of that long hill, so much spoken of lately, called Portsdown. Standing, then, on Portsdown, and looking southward, they will see close beneath the island of Portsea, containing the old town of Portsmouth, a parallelogram of about four miles by two and three-quarters or three miles. Looking to the westward, they will observe the long line of Southampton Water, and immediately on their right front the new line of works covering the suburb of Gosport. Southward will be seen on the sea margin the works which stud the entrance of the harbour, until at last the view is closed to the south-east by Fort Cumberland, protecting the entrance of Langston Harbour. Immediately below them they will see the Hilsea works, with six batteries and two redoubts, resting on the military canal, designed to prevent an advance on Portsmouth by an enemy disembarking on either flank. Fortunate it is, indeed, that attention has been directed so timeously to the essential works of defence.

Since these new works on the former line were commenced, the Hilsea lines have been projected, commenced, but are not yet completed, nor will they be during the course of this year. Within a very brief period projectile science has been so largely developed that, notwithstanding the outlay which has been made on those lines, it will be necessary to support them by additional works. There is no doubt that, to complete the defensive works, Portsdown Hill must be occupied. On the map is traced a zone of fire, taking the Dockyard as the centre, which is maintainable by the new system of projectiles; and, indeed, since that trace was first drawn, with abundant scope, as it then appeared, 1,300 yards additional have been obtained. Taking the Dockyard as the centre of the zone of incendiary fire, 8,000 yards overpasses the whole of the works now erected for the protection of Portsmouth. A bolt was recently projected 9,300 yards. Now the point at which Ryde Pier springs from the shore is distant from the centre of the Dockyard 8,800 yards. It is, therefore, evident that means must be adopted to remove, or impede, or interfere with, the power of the enemy to approach to such distance as may enable him to harass and annoy the garrison at long range, or, as in the case of the Dockyard, to destroy it by incendiary fire.

The works on the Gosport side, forming the Gomer-Elson lines, are well worthy uttention. Their trace is very remarkable. Four have been

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added to the original Fort Gomer to the northward; Forts Grange, Rowner, Brockhurst, and Elson. The position of these forts is marked on the map; and the three central forts have added to them a rear keep, in order to the maintenance of a substantive defence. They are worked out on that trace, that, in the event of one work being taken, it will not give an enfilade to the lines of the others. They are thus each capable of substantive defence, and if any one work were captured it would not lend facility for the capture of its neighbour, right or left. And it is evident that the ground in their rear may be swept by the fire of *rasé* hulks placed in battery in the upper part of the Harbour. Peewit Island might be occupied as a battery. But the independent character of these works is not their sole merit. A very large extent of adjacent land, amounting to 1,600 acres, is in the possession of Government, and will be eventually converted into one large parade ground. Thus will be attached to one of the greatest British arsenals, the finest parade ground in Europe in peace, and if the enemy should land and attempt to take Portsmouth from this direction, a magnificent plain studded with armed *points d'appui* and offering intervals of manœuvre to the troops.

I cannot here fail to remark a particularly beautiful application of engineering science. On the Gomer-Elson lines the ground is diluvial and of a very crumbling nature. The works are all excavated from the level, whence the *terreplein* of the work remains as an isolated block supported solely by the scarp. At Fort Elson the work appeared to be complete, when in one night the scarp was projected in mass ten feet into the ditch. It was therefore clear that the fault was not in the construction, but in the inability of mere brickwork laid at such a slope as to forbid escalade to resist the outward pressure of the shifting earth in the rear of the scarp. How was it then possible to resist the continual and unabated pressure, since the ground having once began to slip continued its outward motion? In rear of the reconstructed scarp, arches were turned like the dry arches of a railway viaduct, so that the whole of the scarp rested against their ends, the parapet above being sustained by the arch itself. As the earth from the interior gradually subsided into these arches it could be carried away, and thus an operation which might have been a source of continual expense, was limited to the labour necessary to relieve these works by hand. A very scientific application of the construction appropriately called the *escarpe en décharge.*

The inland lines of Gosport, Portsea, and Portsmouth, now lie far within the new defensive works. They are of a slight trace, and they would very materially depend on a water defence on the Portsmouth and Portsea lines. It is frequently supposed that an open suburb is on all occasions an inconvenience, or always leads to the disadvantage of the garrison. But the practice adopted by the Austrians may be remembered for instruction. Whenever it was desirable to strengthen a position in villages or small towns, the roofs and walls were removed to a certain height, then laying timbers horizontally on the walls, they were covered with earth, so as to make the buildings perfectly shell and fire proof. A suburb may be turned to advantage, and very materially delay the capture of a fortress. It is true that here the solid, powerfully con-

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structed buildings necessary to make such a defence as that of Saragossa do not exist, especially in the suburbs of Portsmouth; but the defence might very materially be aided and protracted by turning to account the mass of buildings that mask the glacis of Portsea and Portsmouth.

And now it will be perceived how materially the command from the crest of Portsdown Hill, 450 feet, taken as a base of *emplacement* for artillery fire at long range, has changed the conditions of the internal defence of Portsmouth, as developed on the northern side of the island. It is not pushing a principle to extremity, to assume that the necessities of position urgently require the formation of a camp, or entrenched position, whereof Portsdown should form the centre or curtain, and Emsworth and Fareham determine the salients of the eastern and western bastions. The concentric lines of defence will then be clustered around Portsmouth proper, thus: Inner line—Portsmouth and Portsea lines, with the dependencies of Southsea Castle, two batteries, and Lumps Fort; on the westward, Gosport lines and Block House Fort. The outer line of defence to the eastward rests on Fort Cumberland by the sea; on the Hilsea lines to the northward; and is taken up on the westward by the Gomer-Elson lines, continued along the Alverstoke lines from the Browndown Batteries, through Gillkicker Battery, to Fort Monckton. The northern front is covered by the entrenched camp. From the crest of Portsdown there is an ample space for a powerful mass of fire. From the lines of Hilsea can be also concentrated a most powerful fire from six batteries inclosed in a solid rampart, and from two redoubts of the Ravelin trace, against an enemy, advancing from either direction, in order to turn the hill. The fire of these works is projected on parallel lines of fire, set at a large angle to each other, and thus securing a practical convergence of the first order; the prolongations of the respective portions of each work are directed on the least available portions of the country; and it becomes almost impracticable to enfilade by round shot, or seriously to annoy by shell the defences on the convexity or concavity of the *polygone renversé*, on which these works are traced. But, since military expeditions are now prepared for the accomplishment of an object by the combination of a multitude of small co-operating causes, as well as by the employment of a proportion of large means, it would probably enter into the scheme of an enemy, and would certainly be within his power, to place himself in the actual condition of works existing or projected solidly on Hayling Island, and use that position as a base of operations whence to annoy Portsmouth, or as a focus of artillery fire for its destruction. Is it not, therefore, desirable to construct works embracing within their combined curves of fire a very considerable portion of this island? It is proposed to construct two forts, not of the Maximilian trace, because it has been proved how thoroughly their armaments have been dismounted by field fire; but such works as, while enjoying a sufficient command of the country, should not expose a full front to fire in accomplishing the great object in war, the removal of the breaching power of artillery to the maximum distance.

It is probable that there are few spaces of ground of the same capacity and accidents as Portsdown Hill, in which there is so much dead ground. That will be the great difficulty to overcome in occupying Portsdown,

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which being unoccupied, the gates of Portsmouth are left open, and its works uncovered to the first expeditionary corps disembarked on the coast. With regard to the construction of any proposed work, the advantages of material are great. The chalk is of great tenacity, and will stand with but little revetting.

The long ridge of Portsdown Hill measures, from the Nelson Pillar, west, to Belmont Castle, east, about 5 miles 2 furlongs.

The breadth of crest varies from 60 to 200 yards.

The crest line undulates with seven principal points of emergence.

The southern slope is steep, and indented into five principal hollows: the northern ascent is gentle.

The crest of the hill is about 7,040 yards from the centre of the dockyard, in an air line, which is therefore within the zone of incendiary fire from batteries on the western summits.

Works constructed on either extremity of the long axis of the hill would dominate the contained space of a circle inclosing Havant, part of Hayling Island and Bridge, Portsea, Fort Elson, and Fareham.

The possession of this height must then give a great preponderance, as affecting objective points of combustion, and it should be so occupied as to be capable of a substantive defence; and this effectual occupation may be effected by the minimum of labour, as the line of attack can always be exactly foreseen, and reduced to an alternative certainty.

But a peculiar geological formation of this hill enforces such a distribution of the works, that no dead ground should be permitted either on the crest or slopes. It is therefore proposed to excavate seven forts, of which the superior slope of the parapet shall be below the natural crest line at the seven dominant points; and to determine five batteries on the southern slope to search the hollows of that face with fire from their flanks, as well as to disturb any expeditionary movements of an enemy on the plain below, and to assist in defence of the slope from direct assault from the railway level. The northern slope receives its subsidiary defence from the covert way, running, as will be shown, below the crest on that face.

Now, it is essential that the inner crest works should have a double command, to north and south; and the outer crest works an additional command, as has been said, on the prolongation of the longer axis of the hill.

The fire must not be too plunging, and the batteries should be so placed as to have little to dread either from enfilade or vertical fire.

The ground lends itself singularly to these postulates, wherefore it is proposed to excavate works on an oblong trace, to consist, in one portion, of battery and magazine, in the other, of barracks.

The battery to be mounted on the outward faces, and to be entered only through the barracks.

The whole to be excavated from the solid chalk, with brick linings where occasionally required, as at the angles of galleries.

The work to consist of ditch and rampart; and within the excavation will remain the solid block to be hollowed into magazine and barracks.

Mortar platforms might be placed on the roof of the magazine and barracks.

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The communications would be maintained by a sunken road, or covert way, with tramway for transport of heavy stores carried below the northern side of the crest of the hill.

Approximate length of works, 440 yards.
" breadth of work, 220 "

The advanced batteries to be cut back into the hill, and protected from rolling shot or shell by roofs sloping from the upper ground, as in the road and galleries of the Alps. Their communications with the upper works to be maintained by winding roads, sunken, as may be seen in the existing cart tracks, on the face of the hill.

The upper edge of the natural glacis on the southern slope coincides with the limit of cultivation. It is proposed to draw a sunken road along this line, having a parapet to be maintained by the musketry fire of volunteers, and with heavy carronades projected in small caponieres from point to point, to check with their fire the advance of troops up the slope.

The excavated chalk will assist in forming firm ground for docks and quays, as shown in the plan.

The two Montalembert towers shown on the flat of Portsea are designed to complete the flanking defences of the island, and to serve against an enemy established, *en dépôt*, on Hayling Island. Farlington is stockaded, and inclosed within musketry lines.

Farcham furnishes an excellent polygon of defence; and a work capable of a substantive defence, at the junction of the Fareham and Titchfield and the Stubbington roads, would make Titchfield, with its inundations, a valuable bridge-head.

As regularity of fire from heavy ordnance is of more importance than rapidity for the defence of Portsdown Hill, the armament has been restricted to a small proportion of the heavier description, but the ramparts and parapets have been so arranged as to permit the transfer of ordnance to the side attacked.

And it is to be remembered that, as these works will be occupied only on special occasions, it would be necessary to detail no more than the actual number of officers, non-commissioned officers, and rank and file, required for the defence of the works, at the rate of two-thirds of the gun-detachments for the artillery service, and a proper proportion of infantry, without including in the establishment of the Portsdown system the mass of non-combatants required for the maintenance of works permanently garrisoned.

The general details of numbers for garrisoning the suggested works will appear in table; for it is essential that in the consideration of the defence of the district, an approximate estimate of numbers should be formed, the garrisons of the works completed or in progress being already decided on by superior authority.

But now comes the question of permanent fortifications. It is said that if a large outlay be made on defensive works, these works must be kept in serviceable condition by means of a large and expensive establishment, at a needless cost, when their service is not required; and that when occupied on a war footing, the garrisons are withdrawn from active service in

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the field. With regard to the first remark, the problem is to proportion the minimum of defensive preparation to the normal numbers of troops on a peace establishment. With respect to the second, that objection was, I apprehend, very valid and reasonable in the old system of continental warfare. For if the projected works be considered as mere depôts of troops, as the fortresses of the Elbe, the Oder, and the Vistula in the campaigns of 1813 and 1814, by Napoleon during his reverses; if a garrison be allowed to remain passive spectators of manœuvres in the field, dynamic results are incommensurate with outlay. But if the due advantage be derived from their use as points of appui for a field force, which is the appropriate use of works like these on the Gomer-Elson lines, if they are so constructed as with a small garrison to make a substantive defence, while under their cover troops of manœuvre impede the march of an advancing enemy, then due tactical results will follow their adoption, and the national resources not have been diverted to a fruitless expenditure.

An important movement has recently arisen in this country, and one having especial significance in relation to defensive works. I refer to the organisation of Volunteers, who will doubtless verify the hopes of their country; and from this force may be drawn the materials for the special service of a strategy based on field movements appuied on fortified points, posts, and positions. In considering the functions of the national forces, it is not intended that the Militia, or Army of Reserve, should, except in the spirit of soldier-like emulation, become rivals of the regular Army, or that the auxiliary masses of the Volunteer Corps should be called on to perform other than appropriate duties. But, the Volunteers having shown an aptitude for the particular duties of defence, have satisfied many that, whereas it might have been formerly an injudicious policy to add to the extent of existing defence, that now the Volunteer movement justifies the construction of defensive works necessary to a complete system. And not only as regards the special employment of Volunteers for field movements of an irregular character, and the defence of posts by musketry fire, but also in serving the ordnance of field and other works by Volunteer gunners. In Great Britain there are now probably 150,000 Volunteers, of which 15,000, or 10 per cent. are Artillerymen. Time and training are needed to give that impassibility under fire which is the essential requisite of the Artillery soldier; but on the consideration of manning works, these 15,000 Artillerymen, exclusive of officers, will do their duty if they are properly trained to the specific service, and represent an aggregate of 1,500 guns. For in calculating the available strength of Militia and Volunteer Corps of Artillery, one-tenth of the entire body represents the number of gun detachments, there being no deductions for artificers or miscellaneous ordnance duties, as in the Royal Artillery, nor for sick or employed men; and, from the nature of the service, reliefs would not be required in the rigid proportions of a regular siege defence. For the service of the dockyards, it will be advisable to revive the dockyard battalions on emergency. It is doubtless true that the shipwright and anchorsmith should be shipwright and anchorsmith, and nothing else, in ordinary times. But great needs master economic axioms, and it is not improbable that the shipwright's task would be suspended per force when the guns of a breaching battery were opening on Fort Cumberland,

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or gunboats sending their fiery hail athwart the harbour. Is then the proficiency required obtainable without sacrificing the hours of valuable labour? The recorded facts are these.

In 1847 the Dock Yard Volunteer Battalions were formed at the Seven Home Yards and the three Victualling Yards.

Commissions, signed by the Queen, were issued in 1849, to the several Officers, who were selected from the principal officers of the yards, the junior professional officers, and the clerical departments—the non-commissioned officers being selected from the inspectors and leading men of trades. Thus a body of useful intelligent men, who must have obtained their positions through their acknowledged ability in their several vocations, were placed over the artizans and labourers of whom the Battalions were composed.

The commissioned officers devoted their best energies to carry into effect the loyal intention which dictated the embodiment of these corps, and gave their attendance after the working hours of the yards gratuitously; they underwent the necessary drill under well selected paid serjeants of the Line and Marine Corps, and adjutants who were appointed from the Royal Marines and Marine Artillery. The zeal they evinced as well as the discretion they showed in handling bodies of men who, as skilled artizans, were likely to have objection to a position new to them, was most creditable.

The men surprised every person who witnessed their practice with field guns at targets moored afloat, as well as that made by the Boat Brigades, and with small arms, and they became qualified to prove a most useful auxiliary corps to the Professional Gunners for the defence of our Naval Ports and Arsenals. If it be urged that they might fail when under fire, the answer must be that there are no men more frequently subjected to serious cuts and blows, and that being Englishmen they would do their duty under any circumstances, and more particularly if called to defend their homes and country.

The drills took place within the Dock-yard Gates, and continued twice a week for two hours during the summer months, after the working hours of the yards. The effective strength of the whole of the Battalions, which were subsequently ordered to be drilled to the guns as Artillery Corps, may be taken as between 7,000 and 8,000 men and officers, and the amount of cost was about £9,000 per annum, which sum was taken in the Naval Estimates under Vote No. 8, "Wages," for the years 1850 to 1855, besides the cost of clothing.

In December, 1857, the several Battalions were reduced, the staff discharged, and the guns, arms, and stores returned. The officers were allowed to retain their equipments, and are anxiously expecting to be again embodied to join in the Loyal Volunteer Movement, which has been so strongly developed in all parts of the country.

This statement proceeds from an active F. O. of the Dockyard Battalions, and Lord John Russell stated in the House of Commons, Feb. 18, 1848, that the Dockyard Battalions, which numbered 9,800 gunners, had in charge 1,080 guns; being an excess over the previous calculation resulting from the smaller class of ordnance then in use.

Now these Dockyard Battalions of Portsmouth would release a force sufficient to man the works of Portsdown, or the detail given in the appendix, and a very large proportion of the new works.

In the year 1806 the garrison district furnished Artillery as follows:—

Portsmouth . .	225	Hayling . .	83		
Portsea	225	Gosport . .	86	=	613

I now come to the consideration of Portsmouth as a base of operations against an invading force. I have had it strongly impressed on my mind for some years, that for political and social reasons, on which I will not at present dwell, whenever from political reasons it may be considered expedient to make an attack upon England, that attack will be made on a gigantic and unprecedented scale, in result of a formidable alliance, and by simultaneous movements on several points of Great Britain. If I am

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not misinformed, the original plan of campaign in the Crimea was that of convergent attacks directed simultaneously on several points. It is believed that this plan was not approved of at the English headquarters, but was a scheme suggested as a French plan of campaign. Consequently it will be observed, in considering the fixed condition of the position of defence against invasion, first, that it is a felicity of our insular position that the various points of attack can as clearly be anticipated by the English Government, as predetermined by the invading powers. For, although the earliest point of attack cannot be precisely assumed, yet, knowing that it must be one of several, it becomes easy to provide against the contingency, by holding the means of defence in hand until the enemy has developed his plan of operations. In fact, the landing-places of England are *points obligés* either for attack or defence, and, in favour of the latter, a privilege vouchsafed to few nations. On the sketch map are laid down the general features of the shores of the country districts of the South Coast within which would probably lie the points of disembarkation by an invasion in force, either by expeditions in chief or by subsidiary corps.

An attack on Plymouth would probably envelope all the country below this range of hills lying between the Exe and the Tamar. And thus the provident sagacity of General Roy would be confirmed in marking out an entrenched camp to the west of the Tamar to cover Plymouth on that side, nearly 100 years since. If the enemy restricted his first onset to Portsmouth, the attack would probably be conducted by two simultaneous operations on either flank of the fortress, assuming the objective point to be to the westward of London and in the valley of the Thames. For an invader will naturally trust to overpowering or baffling the efforts of the British forces by his proficiency in strategy and manœuvres, and will therefore betake himself to the country which allows him ample room, and an opportunity of striking a blow effectively on the communications of London. That ground will be found in the valley of the Thames, probably near Reading. Then with regard to the northward, I have assumed that an expedition might be projected on the Cheshire Coast where troops might be disembarked in the estuary of the Dee; on the Lancashire coast, probably in Morecambe Bay, for the purpose of confusing and harassing our manufacturing population; on the north of the Tyne, to intercept any march of re-inforcements from Scotland; and also on south of the Humber. One of the most dangerous points of England for facilitating invasion appears to be the south of the Humber along the crest line of the Lincolnshire wold, whence it is practicable for an army to penetrate deep into the Midland Counties without much risk of being harassed on the march. Flank attacks by expeditionary corps up the Bristol Channel and on the East Anglian coast would envelop the country in one great net of threatened invasion.

Reverting then to the tactical and strategic considerations which determine the military importance of the district immediately dependent on Portsmouth, it will be seen that the country lying between the Avon, west, and the Adur, east, has special characteristics of high value. It offers, in fact, a mass of direct resistance to an enemy manœuvring on any line between Portland and Eastbourne, and the defensive front is generally as

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one to three of the depth of the base line. It will now be surveyed in detail, observing its natural and artificial means of defence.

A point to the west of London being assumed as the objective point of an enemy (and it was on this supposition that the camp at Aldershot was formed), the Portsmouth district would contribute largely to the defences. For, though Portsmouth fortress might, perhaps, be masked, the district itself could not safely be neglected, and left on flank, or in rear, by a manœuvring force, since the troops occupying the district would operate on interior lines against an enemy advancing from either flank to their north-east or north-west on the capital, or on the objective point before suggested. If the advance of the enemy bore to the north-west from the neighbourhood of Brighton, in order to avoid the rough ground and gorges of the weald and the North Downs, then from the Portsmouth district a corps might be detached to hang on the flank of the advance until the troops were in junction with the Aldershot divisions. If the advance were from the New Forest to the north and north-east, the same manœuvre would be effective in reverse; if from both flanks at once, then the duty would be effectually performed by intercepting the enemy's communications between his divided columns. And in any case the country lying within the Portsmouth district might be left with a diminished force, yet so as to effect the means of rallying troops, retiring not in panic, but on strategic justification.

The Portsmouth district comprises the ground between the rivers Adur and Avon, on the east and west; the northern boundary stretches from Steyning along the downs, through Winchester to King's Sombourne and Bossington. The coast line from Red Bridge to New Shoreham defines the southern limit.

The country lying between the Adur and the Avon is distributed into five districts, marked by natural divisions, and closed on either flank, with one exception, by rivers, easily convertible into wide and deep inundations. The extreme flanks of this district are prolonged into the interior by canals; and one canal, traversing the Chichester district, forms therein a southern sub-district of defence.

To the north-east a long range of down country dominates the plain, with a rapid northern slope: to the northwest the high table lands on either hand of Winchester complete the border, within which lies a well-wooded and well-watered region.

The military organization of this district is detailed in the Appendix.

The defence of the district *A*, or New Shoreham, is not very important, though easy of arrangement.

Here, as in the other river districts, batteries of enfilade may be constructed to prevent the enemy from crossing the inundations. Guns might be obtained to any extent for this purpose; from the Arsenal, or even from the lines of Portsmouth.

The importance of the district *B*, or Chichester, is considerable, and is of a two-fold character; the light infantry defence of the down line to the north-east, and the standing defence of the line of river, and of the canal.

The Portsmouth district, *C*, is considered independently of the *enceinte* of the garrison, or of the resources furnished from the Royal Navy. It

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enjoys the advantage of a triple railway service, but it is must not be forgotten that while railways assist in the concentration of troops which prepares success, the same concentration, becoming congestion, aggravates defeat, as was seen in the Italian campaign of the past year.

The Winchester district, *D*, on its north-eastern edge must be defended by the manœuvres of trained troops, and therefore steadily watched by the reserves of the central district, *C*.

The Southampton or *E* district has for its stragetic increment that effective resistance which can be offered by entrenched towns and posts covered and flanked by inundations.

Generally, the expedients for defence are endless. The inundations form barriers to an advance on Portsmouth from east or west. They are easily formed, and if barriers be constructed *en étage*, from level to level, not easily drawn off.

The Down line of stockaded village outposts might be strengthened by scarped roads, and other contrivances.

It would probably not be difficult to mount guns on naval slides for service on the railway lines.

The estuaries might be guarded by old hulks serving as gun-platforms and embedded in the mud beyond the reach of escalade or military boarding.

In the interior, where wood abounds, there are abundant means of forming a stockaded camp of refuge to receive non-combatants and stores.

Now with regard to Portsmouth, I have laid off the district thus :— The general defence would be divided into two portions, the defence of Portsmouth as a maritime fortress, and the defence of the district to which this fortress should be as the keep of an entrenched camp, and for an army of manœuvre a base of operations. For general purposes there should be established what may be called the Southern Army of the Coast, assuming Dover, Portsmouth, and Plymouth to be the three main objective points; and a force should be formed for their defence, distributed into three Army Corps, fifteen battalions of infantry for each Army Corps, two batteries of Royal Artillery, and a moveable battery of position composed of heavy guns, with a proportion of heavy cavalry; with the Volunteer Corps of the district, which should be attached specifically to each district until the determination of the enemy was made known. These corps should be massed on the great coast line of railway, with tents, camp equipage, stores, and baggage of every sort, so that the mass might be determined on any point. The railway accommodation and the railway power which would be required for such a force is easy of calculation. Thirty locomotives and proportionate numbers of trucks, waggons, and carriages would be required to move such a Army Corps, and to keep it available on the line of manœuvre, and thirty locomotives are the number allotted for the service of thirty miles of railway. The elements of calculation being given, power and distance, the result may easily be obtained. Sufficient importance is not attached to the strategic facilities afforded by our railway communication on lines of manœuvres or perpendiculars to lines of operation. Yet much remains to be done to perfect the means of military communication. The Great Northern Railway alone can carry chargers

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on cattle trucks. Troops could be moved, concentrated, withdrawn, and dispersed with great ease on the railway lines. A system of railways in rear of Wilna would probably have saved a million of human lives, the conflagration of Moscow, and all the misery resulting from the inability of Russia to concentrate her retreating armies. The force required for the defence of the Portsmouth district is not, by means of rapid co-operation, necessarily very large. The entire periphery of the district to be defended, as shewn in the Appendix, is 150 miles. Therein are projected 13 fortified posts, 72 places of minor importance on the line of the Downs, and 18 small batteries to defend the passage of the rivers and inundations. Fifteen battalions of infantry forming the staple of resistance, of which five should be regulars, and ten drawn from the local militia of the neighbouring counties, would be sufficient to check, or at all events to harass, any force which might be landed, and the service could be performed without drawing on the permanent garrison of Portsmouth.

The Royal Artillery and the Militia Artillery will be disposable, as well as regular cavalry and yeomanry. Other local defences of posts might be in great measure entrusted to the Volunteers, when once properly trained to the duties of their special service.

It has been very justly remarked that the numbers required for the occupation and defence of works and districts are seldom detailed. Nor, indeed, is it possible to do so with perfect accuracy, although a reasonable approximation may be attainable ; but the first necessity is to determine the nature of the defence to be made. In the Appendix will be found a topographical table of the Portsmouth district, (*A* and *B*) ; the number of volunteers in 1806, (*C*); the population of the same district 1851, (*D*); and the armament of the proposed works on Portsdown (*E*).

In considering the space to be traversed by the divisions of the Army of the Coast, it may not be inopportune to gauge the value of the system by the opinion of the most experienced tactician, General Dufour. Speaking of the establishment of fortresses of the 1st and 2nd class, he says, "Intervals of from 50 to 75 miles, in conformity to circumstances of ground, should be left between fortresses. Such is the distance which appears to consist with the great masses of modern armies, and with the present system of warfare. In rear of the first line of fortresses capable of sheltering a beaten army, should be traced a second at 75 or 100 miles. Then one last fortress in the heart of the country, the dèpot of the archives and arsenals, would offer a final asylum and anchor of security to its defenders. Excellent roads made in rear of the lines of defence would connect all these fortresses; they would give the troops power of movement with extreme ease from one to the other, without fear of a false manœuvre in face of an enemy, who, not enjoying the same advantages, is obliged to move on eccentric lines, to surmount a thousand obstacles in order to seize an easy communication to conduct him to his point of attack."—(Dufour, Fortif. Permanent, p. xiii.)

Now since space and time are for manœuvring synonymous, it will be seen that the railway system gives a great advantage in time, while the space required for free movement and choice of position remains unchanged.

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TIME DISTANCE BY RAIL.

	Hours.	Min.
From Portsmouth to Plymouth . . .	13	25
„ Portsmouth to Dover . . .	5	7
„ Plymouth to Dover . . .	18	32

But as railways prepare for victory by rapid accumulation of troops, so defeat is aggravated by the constraint to retire on a single line, or by casual routes previously unexplored.

In the preceding suggestions it is not intended to sketch out a plan of campaign, but to point out the primary formation in which an attack might be awaited; and, considering that the advance of an invading force must be made from one of three bases, previously calculable, it would seem to be no very difficult matter to prepare alternative systems of defence, in any eventuality.

In providing the battalion mass of fifteen regiments, a suggestion may here be made—assuming that the three principal objective *points* of attack on the south coast, *not of disembarkation*, to be Dover, Portsmouth, and Plymouth, it would appear advisable to detail fifteen regiments (battalions) of the line, for coast service alone—to be echéloned on the coast railway, and to be designed to form a flying division for the special service of assisting in the defence by manœuvre of these named districts, with their proportion of guns and cavalry. Allowing five regiments of the Line and ten of Militia to each district, the distribution for Portsmouth would be as follows:—

	Combatants.
Five battalions of the Line at 800 effectives . .	4,000
Ten battalions of Militia Infantry at 800 ditto . .	8,000
	12,000

MILITIA BATTALIONS.

1 Hampshire,	in district	C.
1 Sussex	„	B.
1 Dorsetshire	„	E.
1 Berkshire	„	D.
1 Wiltshire	„	E.
2 Surrey	„	D.D.
3 Middlesex	„	A.B.D.

	Battalions. R.	M.
Or, District A. . .	1	1
„ B. . .	1	2
„ C. . .	0	1
„ D. . .	2	4
„ E. . .	1	2
	5	10

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Considering the Tables C and D (Appendix), and the increased population, it may be fairly estimated that the Portsmouth district would furnish an increase on the levies of 1806.

Excluding then the garrison of Portsmouth, the final estimate might be taken to reach—

Fifteen battalions of Infantry . .	12,000	
Volunteers, Infantry	5,000	
		. 17,000
Royal Artillery (two field batteries) .	484	
„ „ (one of position) .	242	
Militia Artillery	800	
Volunteer Artillery	500	
		. 2,026
Cavalry		. 500
Portsmouth District of all arms, excluding Royal Engineers		. 19,526
Dover and Plymouth Districts		. 39,052
Army Corps of the Coast		. 58,578

Let me in conclusion read to you the appropriate language of our forefathers of three hundred years ago. For I could not willingly let perish from the memories of Englishmen a speech made by Lord North at the Great Council:—"If the enemy is firmly planted, let him be blocked up with sconces, or fronted with a great army, giving him little rest." There spake the spirit of an Englishman under circumstances of heaviest discouragement. It mattered little to that gallant man that he saw arrayed against him men whose warfare had been tried by the stubborn Dutchmen, and by terrible struggles in the Crusading warfare of Southern Spain. It was sufficient for him that the enemy was there; he would have "blocked him up with sconces, or fronted him with a great army; giving him but little rest." (Appendix *F.*)

There is another point with which I shall conclude what I have had the honour of submitting to the meeting. Great attention was paid in those days to the arming of Sussex, and there was one officer, Sir James Colbrond, then deputy lieutenant of the county, who seems to have paid special attention to this. He says, on the last day of January, 1599, "The duty I owe to my Sovereign, and love to my country, hath caused me to write, as moveth thereto, the rather by reason of my observation of the country's unreadiness to march forward in August last, when as for defence of Her Highness' person royal they were hastily called for." He proposes "that the forces of the country should stand in continual readiness by previous organization, so that their duty of mustering should be with ease well or better performed in one day, if need be, more than in seven or eight days as it was aforetime upon the last great call for soldiers for Her Majesty's service of special importance." And he adds this: "All our hopes rest now upon our musquets and calivers, and good weapons they be if kept in readiness." (Applause.) And he concludes thus: "Now to conclude,

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I am thence of opinion that the service will best get forward, and the charge and expense of time be least regarded among all them that serve and find arms, when the trained have justices of the peace and gentlemen of the better sort to be their leaders." Mark that; not one officer who bears the British commission, I am assured, thinks that either courage or good conduct, or the devotion that leads men to death, are the special inheritance of any class. We have had a striking instance and noble recognition of the fact that bravery and energy, truth and good conduct, are native in all ranks in the institution of the Victoria Cross. But it is in the constitution of ordered society that they, to whom Providence has assigned in this world less of its goods and more of its troubles than to their more fortunate brethren, should look of right to those on whom the heavy responsibilities of wealth have been laid, for that self-devotion, and above all things for that sober, loyal, honest guidance which the English people through all their ranks always recognise and appreciate with a proud obedience, unsupported by which they will not be content to serve.

POSTSCRIPT.—The Report of the Royal Commission on National Defence having been published since the foregoing Lecture was delivered, the writer may be permitted to remark on the confirmation which the Report has given to his general suggestion that the defences of Portsmouth must be much extended. The proposed work on Horsea Island, named in the Appendix, would add largely to the strength of that flank of the defence. It may be doubtful whether the guns from the batteries on the Hilsea line can thoroughly search the dead ground on the southern slope of Portsdown, which contains hollows most favourable for lodgement and ascending sap, and the writer would therefore resort to the construction of batteries dependent on the upper works, as stated in the preceding pages. And, while so much thought has been taken to strengthen existing works by new constructions, the weak point lying between the Portsmouth and Portsea lines has not been overlooked.

There would appear to be much arrangement requisite that the tier-towers projected on the shallows of the Spithead anchorage may not mutually blind their fire against vessels of small draught and heavy armament.

The long-range projectile will be probably employed in these batteries, and it might be a matter of renewed inquiry whether gun-cotton might not be advantageously employed in the armament of works of this class, where clear sight of the mark is essential to the development of the powers of the rifled ordnance, especially since fire *en ricochet* cannot be depended upon as in smooth-bore cannon.

The writer cannot refrain from congratulating the country on the production of a Report of a character alike bold, comprehensive, and scientific.

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APPENDIX.

A—Table of Districts.

	A.	B.	C.	D.	E.	
River	Adur.	Arun.	Titchfield.	Itchen.	Avon.	Total.
Chief Town	N. Shoreham.	Chichester.	Portsmouth.	Winchester.	Southampton.	
River line, length	4·4	8·4	14·4	12	12	51·4
Principal Stations	2 N. Shoreham, Bramber.	3 L. Hampton, Bury, Arundel.	2 Titchfield, Wickham.	3 Twyford, Bishopstoke, Bp. Waltham.	3 Bossington, Romsey, Tolten.	13
Outposts	5	7	3	2	12	29
Line of Downs, length	10·4	12·4	12	—	—	35
Principal Stations	3 Steyning, Stonington, Amberley.	3 Bignor, Cocking, W. Lavington.	5 S. Harting, Buriton, S. Meon, W. Meon, Warnford.	—	—	11
Outposts	3	8	4	—	—	15
Coast line, length	10·2½	10		8·4	3	31·6½
Principal Stations	1 Worthing.	1 Slindon,	Garrison.	1 Hamble.	1 Redbridge.	4
Outposts	5	5		1	—	11
Inland line, length	—	—	11	12	8	31
Principal Stations	—	—	2 Hambledon, Horndean.	5 Hinton, Ampna, Cheriton, Titchbourne, Kington.	1 King's Sombourn.	8
Outposts	—	—	4	6	1	11
Batteries on Rivers	2	5	—	5	6	18
Regiments of Infantry	2	3	1	6	3	15
Sub-district P. Posts	—	1	—	—	—	1
Interior Posts	—	6	—	—	—	6

Boundaries of Districts.

A district extends from N. Shoreham to Bramber; by downs to Amberley, thence to L. Hampton, and by coast to mouth of Adur.

B district extends from mouth of Arun to Arundel, thence to Bury by downs to Twyford, and by Beacon Hill to Emsworth, and by the coast to Arun river.

C district extends from Emsworth to Beacon Hill by Bow Hill, thence to W. Meon and mouth of Titchfield river, and by the coast to Emsworth.

D district extends from mouth of Titchfield river to Warnford, thence to Winchester, and by Itchen river to coast and to mouth of Titchfield river.

E district extends from mouth of Itchen to Winchester, thence by King's Sombourn to Bossington, down the course of the Avon to Redbridge, and by the coast to Southampton.

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B—Summary.

Entire length	149·2½
Principal Stations	37
Outposts	72
Batteries, Rivers	18
Regiments of Infantry	15

Mem.—The defence of the Rivers, on both banks, is assigned to the District lying inwards; Portsmouth therefore has two inner lines.

C—In 1806 the Portsmouth District furnished Volunteers as in List annexed:—

Hants	Cavalry, 465	Artillery, 923	Infantry, 4,040
Sussex	„ 172		„ 1,637
	637		5,677

D—Population of Portsmouth Districts—Census 1851—Males.

Havant	3,432
Portsea	35,920
Alverstoke	8,564
Fareham	6,874
Southampton	15,875
South Stoneham	7,605
Romsey	5,377
Winchester	13,146
Petersfield (half)	1,956
Droxford	5,493
Steyning	8,296
Worthing	8,862
Chichester	7,083
	128,484
Deduct Army and Navy	15,000
	113,484
One-fifth of the Population =	22,697

E—Armament of Portsdown Works.

Works.	Ordnance.			Total No. of Guns.
	68-Pr.	8-in.	32-Pr.	
Each.				
Forts—A. M.	4	4	12	40
„ B. F. H. K.	2	2	10	56
„ E.	4	4	10	18
Batteries—C. D.	—	2	5	14
„ 9	2	2	6	10
„ 1, 4	—	2	5	14
	22	30	100 =	152

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F—In June and July, 1588, the Royal Forces were thus distributed :—

	Men.			
1. For the defence of Her Majesty's Person, drawn from the Mid-England Counties .	28,900			
	Infantry.	**Lances.**	**Light Horse.**	**Pioneers.**
2. Field force drawn from the Southern Counties	27,000	407	1,901	4,892
3. To attend on the Lord Steward . .	22,000	203	669	
	Reserves.	**Depot.**		
1. For the defence of Her Majesty's Person	17,600	11,009		
2. To attend on the Lord Steward . .	6,000	11,536		
	Of all Arms.			
3. South Wales	21,664			
4. North Wales	21,344			

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Friday, June 29th, 1860.

CAPTAIN E. G. FISHBOURNE, R.N. C.B. in the Chair.

SHOT-PROOF GUN-SHIELDS AS ADAPTED TO IRON-CASED SHIPS.

By Captain Cowper Phipps Coles, R.N.

My object in addressing this meeting is to explain briefly the successive steps by which I have arrived at certain views, having reference to vast changes which arms of great precision, more especially rifled cannon, are calculated to produce in future warfare.

My attention was first drawn to this important subject during our recent war with Russia.

Some whom I see present are acquainted with the history of the "Lady Nancy," a raft carrying a 32-pounder, which was used during the Russian war with great effect in the Sea of Azof. A model of her is before you: but I will not on this occasion enlarge upon her character. A description of her was published last year.

Finding that a single gun on a steady platform could do so much execution, I next turned my attention to the effective protection of the crew, gun, and magazine. This led to the design of another raft (fig. 1), which is provided with an hemispherical iron shield over a 96 cwt. gun. This raft is composed of numerous empty casks. When under fire, water may be admitted into the apartments containing the latter, so that, the structure being then floated chiefly by the buoyancy of the casks, a diminished area is exposed, and in the event of penetration by red hot shot or shell, ignition would be prevented. It will be seen by the drawing and model that a small portion only can be reached by horizontal fire, and this portion is sloped at an angle of 40 degrees, and faced with 4-inch iron. As to vertical fire, I believe there is little to be apprehended, from the uncertainty attending its effect on a moving object. If a 13-inch shell should strike such a raft it would do little damage beyond destroying one or two casks, the loss of whose buoyancy could well be spared, as the gross displacement of casks is almost one-third in excess of that required to float the vessel at a proper fighting height. It appeared that such structures would be very efficient in attacking the Russian forts under circumstances which would not permit the approach of our heavy draught as well as heavy armed ships.

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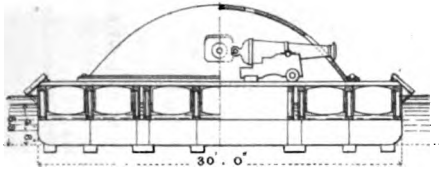
GUN OR MORTAR CASK RAFT WITH SHOT PROOF SHIELD.

By Commander Cowper P. Coles R.N.

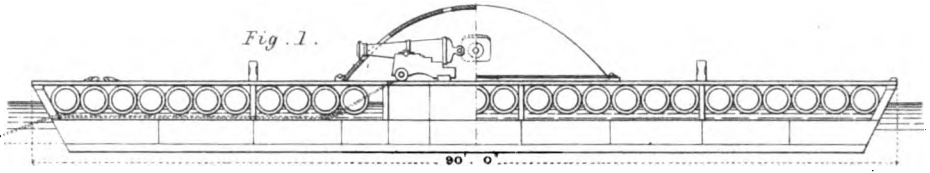
August 1855.

Fig. 1.



Transverse Section

Fig. 1.

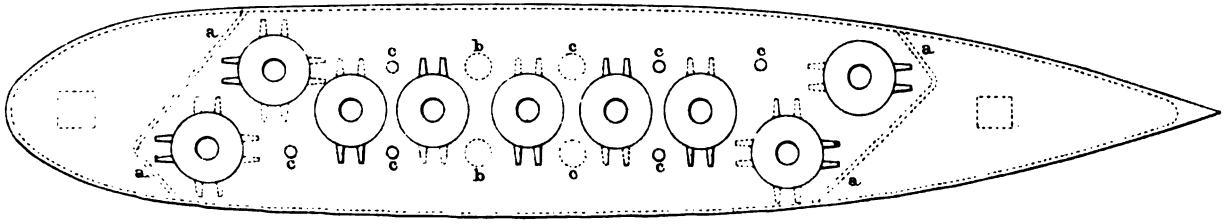


Longitudinal Section

PLAN OF DECK OF SHIELD SHIP.

Shewing the number of Guns that can be brought on either broadside, or right ahead and right astern.

Fig. 6.



The draft with armament complete, one 68-pounder, is only 3 feet 7 inches before the admission of water, and she may be immersed 5 feet 3 inches without bringing the gun within 4 feet 6 inches of the water.

My proposition was that a number of these rafts should be prepared and taken out in portions to the Baltic for the purpose of attacking Cronstadt, one-third of them being fitted with steam power, so that the whole, without any extraneous aid, might proceed to action under steam, passing along the shallow waters towards which the constructions and arrangements of the forts would not permit their fires to be directed. In the meantime our heavy ships could be engaged in the deeper water; and I think there can be little doubt that the easily converged fire would have had an immense advantage over the small amount of fire which could be brought to bear by the forts upon the rafts in shallow water.

In consequence of the favourable Report * of a Committee in November 1855, I was ordered home from the Black Sea, and had the honour of explaining to the Lords Commissioners of the Admiralty the nature of the proposed shot-proof raft and shield. At this juncture peace with Russia was proclaimed, and the Government did not therefore consider it necessary to proceed with these matters. Since then, while on half-pay, I have occupied myself in preparing numerous drawings and models, which resulted in these now before you. †

I will first describe fig. 2, which represents part of the side of an ordinary frigate as now built, iron-cased, to 8 feet below the water-line, two port-holes being represented, each having an area of 13 square feet entirely exposed to shot, shell, and musketry; immediately in rear of which space are grouped the guns, and the crews which fight them. The serious disadvantage resulting from this condition struck me particularly at Kinburn,

* H.M.S. Stromboli, Kazatch, in the Black Sea, 13th November, 1855.

Pursuant to an order from Rear-Admiral Sir E. Lyons, Kt. G.C.B., Commander-in-Chief, &c. &c. &c. we, whose names are hereunto subscribed, have repaired on board H.M.S. Stromboli to inspect a gun-raft proposed by Commander C. P. Coles, R.N., and we are of opinion that the invention is one of the greatest practical value.

It appears by the model which Commander Coles produced that the raft combines many advantages, amongst which are—

1st. Light draught of water.

2nd. Facility of propulsion.

3rd. Simplicity and rapidity of construction.

4th. Great buoyancy; one heavy gun or mortar can be used on each with great precision of fire.

5th. Protection of the crew.

Looking to the probable nature of future operations against our present enemy, we are further of opinion that this proposal merits the immediate attention of H.M. Government; and, in order that the full benefit may be derived from it, we venture to think it desirable that Commander Coles should be directed to proceed to England and personally to explain his proposal to their Lordships.

We further suggest that under present circumstances *secrecy* is desirable.

President.—Rear-Admiral Sir Houlston Stewart, K.C.B.
Captain Arthur Cumming, R.N.
Captain E. A. Inglefield, R.N.
Mr. Rumble, Chief Engineer of H.M.S. Royal Albert.
Carpenter of H.M.S. Hannibal.

Present,—Captain H. Hay, H.M.S. Hannibal.

† The models are to be seen at the Royal United Service Institution.

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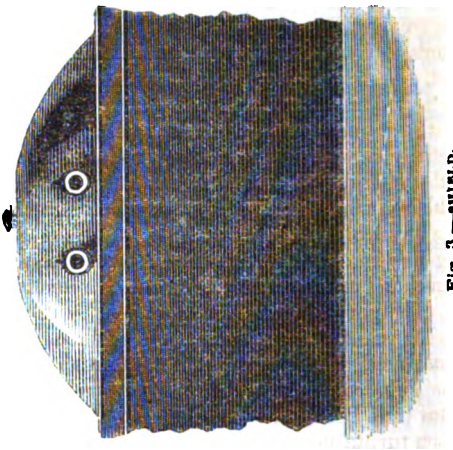

Fig. 3.—SHIELD.

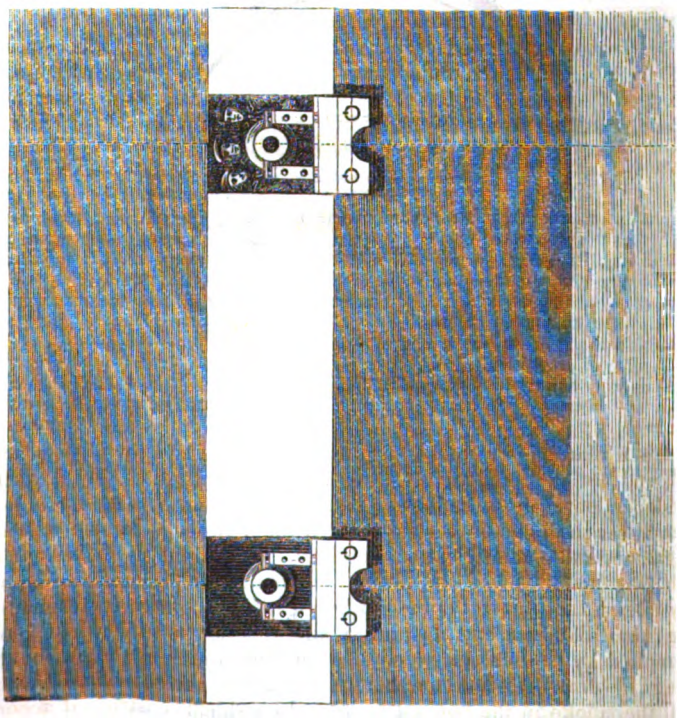

Fig. 2.—TWO PORTS.

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when the French floating batteries experienced several casualties effected by shot entering the ports while under a very feeble fire at the distance of 800 yards. It appeared evident that, with the great precision of fire now attained, even iron-cased ships must thus suffer great loss when engaged in close action under a vigorous fire, particularly from grape and cannister, and that even one shell of molten iron or liquid fire might on entering a port entirely destroy the vessel, or produce a fatal confusion.

Further consideration strengthened my conviction that the coating of a ship with iron plates, and leaving a perfectly exposed area, amounting in the case of a vessel of 20 broadside guns to 240 square feet, would be abortive.

I beg now to draw your attention to the drawing (fig. 3), in which are represented 2 guns, placed under either a hemispherical or a cone-formed shield. The port-hole is entirely closed by the gun, save the small space sufficient to permit an elevation of 10 and depression of 7 degrees. The horizontal motion or "training" is effected by turning the shield itself, with the gun, crew, and the platform on which they stand. The whole apparatus thus becomes as it were the gun-carriage, and, being placed on a common turntable, can be revolved to the greatest nicety of adjustment by means of a winch, or of handspikes at the circumference, or of levers in the pivot.

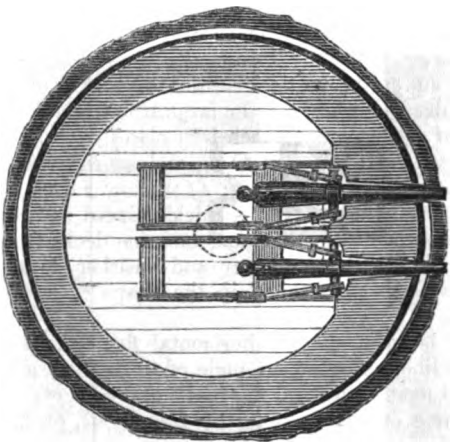

FIG. 4.

Fig. 4 is a plan of the shield, showing the 2 guns and carriages placed parallel, and as close together as the trunnions will allow, but working quite independently of each other. The pivot (see fig. 5, *a a*) is a hollow cylinder 3 feet in diameter, through which the powder is handed up from the magazine, and communication obtained. A current of air is kept up through this hollow pivot by means of a fan, which causes the smoke directly it leaves the breech of the gun to escape through the corresponding opening immediately above it; and should this not be sufficient, a blow-pipe supplied by the fan can be entered into the breach of the gun before the plug is drawn, which on being raised the current of air would force all the smoke in the bore outboard. In a shield constructed according to my invention, the interior *b b* is a wooden dome, composed of massive

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vertical parts mutually supporting each other, and tied together by means of bolts and a hoop.

The whole exposed upper portion, *c c*, above the glacis is covered with 4½-inch plates, and the other part is sunk into the deck, and protected by an iron glacis.

Aim may be taken either through a "sight" fixed on the top of the shield, or on the gun, or two may be found advantageous, that on the shield performing the same office as the small "finders" of a large telescope, the shield being as it were the carriage of the gun, and the two always retaining the same relative position.

Although there is a height of 7 feet inside, there are only 3 feet 8 inches exposed above the glacis, consequently there is only a small exposed area. From its globular form no horizontal shot can strike it except very obliquely, when the shot would glance.

No shot has yet penetrated a 4½-inch plate at any considerable angle. Fig. 3 represents the apparatus placed amidships in a flush deck vessel; and fig. 2 two broadside guns of the same calibre out at the perpendicular sides of an ordinary built ship. It is evident that the first shot of a rifled gun might enter the port of the latter, destroy several men, and disable the gun by direct injury to it or the carriage, whereas the shield gun presents nothing but its muzzle. Moreover, the latter trains through the entire circle, the ordinary mounted gun only through an arc of 45° each way.

Fig. 5 shows an entire vertical section of a ship of the same general dimensions and draft of water as the large iron frigates now being built: one side, *d d d' d'*, represents 4½-inch iron plates over 18 inches of timber backing, supported by an iron framing and an inner skin; *e e* would be the main deck of an ordinary frigate; *f f* the lower deck. The main deck is occupied by the turntables for the shields placed amidships of the deck, supported by numerous iron stanchions between decks from top to bottom. The communication with the lower and weather deck is by means of a 3-foot hatchway to each shield in the shape of a hollow cylinder or pivot, *a a*.

Now, it will be seen that no horizontal fire can strike this structure above the water line, except at an angle of 40 degrees, and that it is completely protected against vertical fire by its arched roof; it is supported on each side at three or more points by stanchions, or fore-and-aft bulkheads if necessary.

An enormously strong ship is thus obtained—not weakened, as are ordinary ships, by numerous portholes, but having a continuous side, with the weights placed amidships instead of at the sides.

The experience furnished by the late gales of the effects upon the heavy wooden ships of our fleet, when after a few days' bad weather they were all more or less damaged and unfit for any continuous service, leads me to the conclusion that the enormous iron-coated ships now building, of great beam, with immense weight of iron on their perpendicular sides, will strain themselves exceedingly, and require constant expensive repair, or soon be rendered altogether unseaworthy. Water getting between the iron plates, parts to which the sun can never penetrate, will always be in a state of moisture. This I believe to be one of the causes of the "Trusty" being rotten.

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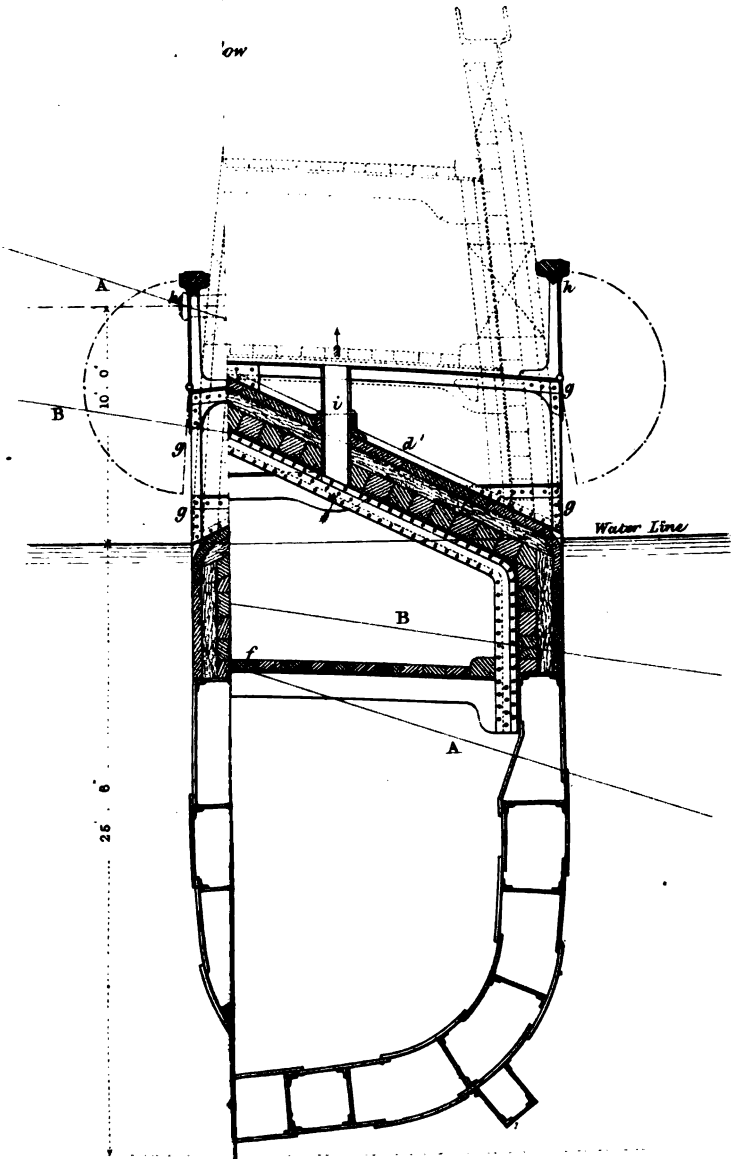

A. Waterside Gun in Ordinary Ship is in the Water
B. D°. . . . . is 5 Ft. out of the Water
i. Ven

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As a ship of this form with inclined sides, *d d d' d'*, would have no stability, she would be a bad sea boat, and be washed over by a sea, owing to the absence of sufficient extra displacement.

A second or outer side, *g g g g*, is therefore provided with numerous compartments of iron plates as lightly constructed as consistent with the strength requisite to resist a heavy sea. It is fitted with a falling iron gunwale, *h h*, to allow the gun to be fired over all. A good deck on either side of 18 feet breadth is also thus afforded.

The compartments should be kept perfectly empty, excepting a space required for the stowage of boats. The accommodation below is the same as that of an ordinary frigate. There is ample provision for ventilation in a hatchway of 3 feet diameter, and a corresponding open space at the top of each. There is also room for a hatchway on both sides between the shields. The main deck being secure from water may consist entirely of grating work, or be quite open between the beams, so that the height of two decks is thrown into one for air and light. Durability and prevention from decay is another important feature in these ships. Water cannot get into the inner portion of the structure without first passing through the outer coating. Those who are aware of the destructive effects which are sometimes caused by the penetration of water to the unventilated parts of a wooden fabric, will appreciate this feature.

With reference to steadiness in a seaway, it is clear that from the iron-cased portion inclining inwards, as well as the position of the heavy guns and shields amidships is more favourable than that of the armament placed in the ordinary way through heavy vertical sides; and it is unnecessary to enlarge upon the extreme *desirableness of steadiness of gun platform in a vessel of war*. The very act of working guns on the broadsides causes our present ships *to roll several degrees;* but here, the gun and appurtenances being in the centre, the movements would be comparatively insignificant. Moreover, when the muzzle of a gun at the side would be under water, that of a gun placed amidships would be perfectly clear of it, and with a given roll of ship the former would pass far more rapidly through a greater distance than the latter in describing a similar arc.

In shields the captains of the gun being able to see the masts of the opponent above the smoke would always keep the object covered, so that the gun would be fired as soon as loaded, without any further training: much would thus be gained in rapidity and precision of fire. The shield would contain two guns each; and I so place the foremost and aftermost shields, that four guns can be brought right ahead or right astern without transporting from broadside to bow ports (see fig. 6), as required by the ordinary port system. Indeed ordinary iron-cased ships cannot have bow or stern ports without incurring the risk of being raked, and of their battery being disabled through the ports. A raking broadside could do little or no harm to a shield-ship such as proposed. She has the power of concentrating her broadside with great precision, the degrees being marked on the circle. From each shield two 100-pounder shot can be thrown simultaneously within 3 feet of each other, by merely connecting the two trigger lines; and, if boarding were attempted, they could sweep the upper deck with grape and canister, each gun clearing its own portion of the deck; and 8

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guns, four aft and four forward, might rake the deck right fore and aft at the same time. Indeed it may be safely affirmed, that no enemy could for a moment stand upon the deck, whilst the crew of the vessel would be perfectly secure within their iron shield.

In future warfare, when iron ships become general, in conjunction with the power under steam of closing at pleasure, a determined enemy may prefer the issue of a hand-to-hand combat to the fruitless waste of projectiles on an almost invulnerable hull. For such a contingency it is well to be prepared, and, judging by the results of bygone days, we have no ground for discouragement, should boarding, as in old Roman and Grecian times, be again the ordinary way of meeting an enemy.

I will now point out the comparative destructive powers obtained through the shield and the ordinary port system. The two drawings (figs. 2 and 3) show the comparative lengths of longitudinal space required for 2 broadside guns on the two principles. Two broadside guns on the old plan, with 3 feet 6 inch ports 12 feet apart, occupy 31 feet. Two guns under the shield occupy longitudinally 20 feet; thus one-third in space is gained by the shield, and it will easily be seen that one-third less length of ship is required to be fortified when mounting the same number of broadside guns. Although these guns are of the same height from the water, this ship has much less area exposed, being much lower and of less length than the one with port-holes. This is a decided gain to the shield-ship in weight, expense, and the chances of being hit.

I must beg you to bear in mind, that in all my calculations I compare broadside with broadside, and not the number of guns that a ship carries: for example, we hear of 120-gun ships, but it must be remembered, that they can only bring 60 guns to bear on one broadside. The shield-ship brings the whole of her guns to bear on either broadside, and 4 guns right ahead or right astern.

I will take first for example a ship with perpendicular sides coated with iron (see fig. 7), according to the present system, with the general dimensions of the "Warrior," which is 380 feet long, and, although she has a broadside of 18 guns, only 13 of these are protected by 4½-inch iron, requiring 213 feet of longitudinal iron-plating. A ship of the same general dimensions on the shield plan would have 20 broadside guns thoroughly protected, as before described, by 4½-inch iron. In my comparisons I will consider those guns alone to be protected, as it is hardly necessary to point out that a three-decker's broadside would soon put *hors de combat* those unprotected, then the destructive power of the shield-ship would be to the other as 20 is to 13.

But suppose a shield-ship built with a broadside of 18 guns all protected by 4½-inch iron, she would only require a length of 180 feet to be plated with iron, whilst the "Warrior," for the protection of only 13 guns, requires a length of 213 feet. Figs. 7 and 8 show the relative broadside areas of the two ships, from which it will be seen that the shield-ship, requiring so much less space for her guns, may be much shorter, and, therefore, not only less costly, but by far the handier of the two.

With regard to strength and power of resistance it would be difficult to draw a comparison, the side sloping at an angle of 40 degrees having so great a superiority over the perpendicular; but we may form a near

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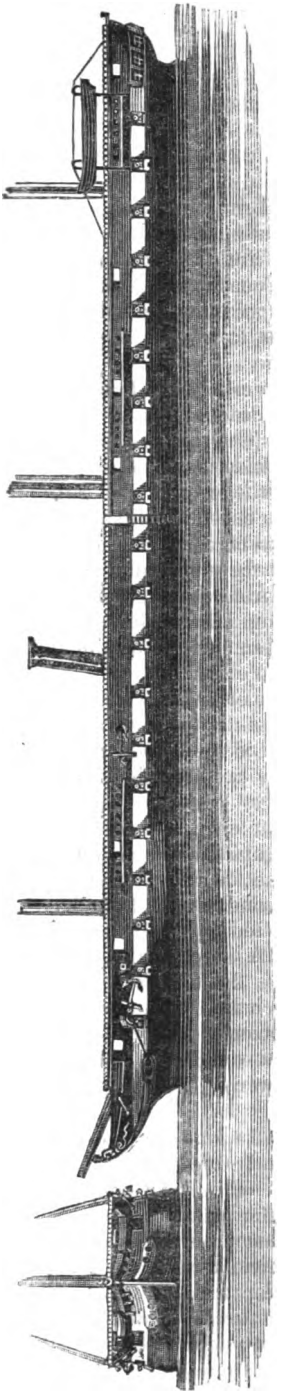

FIG. 7.

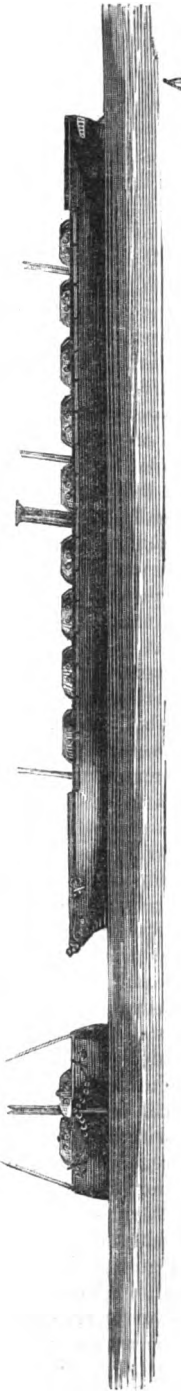

FIG. 8.

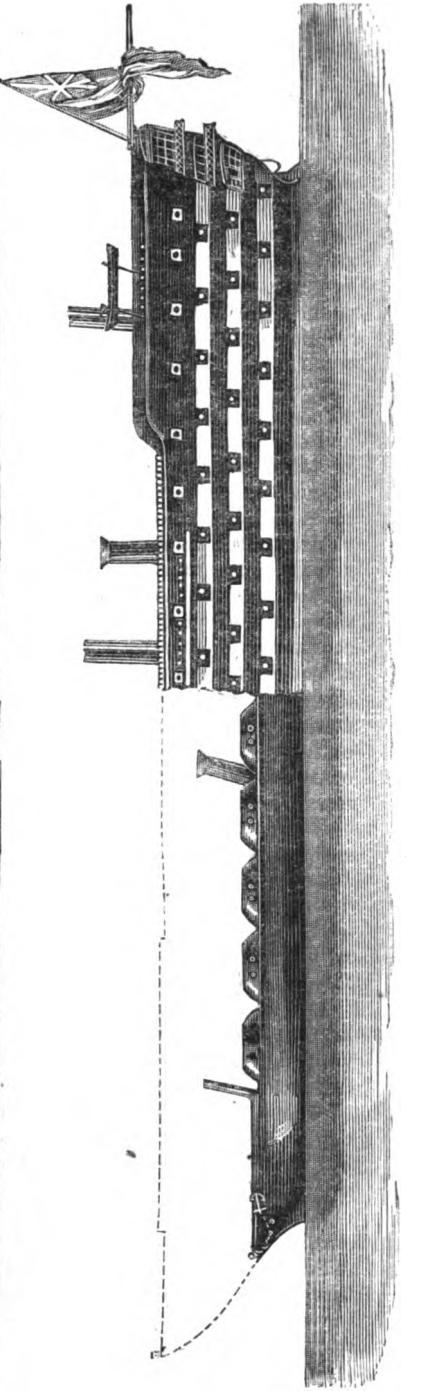

FIG. 9.

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enough estimate with reference to the entirely unprotected portion of the respective ships.

The ship (fig. 7) with 18 ports, 3 feet 10 inches by 3 feet 6 inches, has a space of 241 square feet open to horizontal fire, and an enormous upper deck unprotected against vertical fire. The shield-ship has no opening large enough for a 32-pound shot to enter horizontally, or through which riflemen can do any execution. Against vertical fire they are entirely protected, except the small hole in the centre of each shield, and the chances are very much against this being hit. Should a shell strike this sloping structure, I imagine it would glance off, or, at all events, do less damage than plumping down on a flat deck.

I will now compare its powers of resistance and destruction with those of a wooden 3-decker. Fig. 9 shows the half broadside of a shield-ship and of a 3-decker, the hulls being of equal length. The shield-ship has a broadside of 20 guns, 100-pounders, the 3-decker a broadside of 60 guns of various calibres. I will first call attention to the comparative areas to be aimed at, and the chances of being hit. The 3-decker presents an inflammable area, vulnerable to shot, of 10,150 square feet; the shield-ship, 3,750 square feet, both invulnerable to shot and uninflammable.

It must be remembered that after the first two or three broadsides the ships become enveloped in smoke, little or nothing is seen beyond an occasional glimpse of a mast peering through the smoke, giving the low object then a great advantage over the high one. We know, also, that as the guns get hot the quoins are liable to fly out, or elevating screws run down, throwing the elevation out, and causing the shot to pass over the object. It may be asserted that one gun protected is equal to ten in the open, and a gun in the open is better than one badly protected by inflammable, splintering materials.

Taking into consideration then all the above advantages, I believe I am within the mark when I state that one gun covered by a shield is equal to 10 guns in a 3-decker. This would give a ship with 20 guns in shields a destructive power equal to 200 broadside guns in a 3-decker; but, as the latter has only 60 broadside guns, the comparison will be as 200 to 60, or 10 to 3 in favour of the shield-ship. I have then shown that three of these shield-ships would be equal to ten 3-deckers.

Let me next draw your attention to the relative outlay and expense of keeping these vessels in commission. The average cost of the shield-ship with the present iron ships building would be the same; but, taking broadside gun for broadside gun, the shield-ship would be by far the cheapest: for instance, I believe the largest iron frigates building are to cost £320,000, with 18 broadside guns, only 13 of which are protected by iron; but a shield-ship of the same size and cost would have a broad side of 20 guns, all of which are protected by iron.

I will now touch upon the great saving of manual labour, a point of no small consequence in these days, independently of the question of economy.

A gun carrying a 100-pounder shot in the shield can be worked by three men, but say five, viz. one to direct and keep the gun bearing on the object, two to load, and two to attend to the turntable and supply ammunition. The carriage is self-acting, the gun running in and out without being touched.

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This carriage has already been tried, and so far succeeded, thus an enormous amount of manual labour is saved: but, as a relief and spare men for other duties would be required, we will allow 10 men to each gun, thus requiring 200 men for the shield-ship of 20 guns, whilst a 3-decker requires 1,000 or 1,200 men. One shield-ship equal to cope with and destroy three 3-deckers (as before shown) requires only one-fifth of a 3-decker's complement of men. Then with one 3-decker's ship's company 5 shield-ships are manned equal in power to 15 3-deckers, so that with the same number of men, wages, provisions, and manual labour as 3 3-deckers, 15 ships of the shield plan can be maintained equal to 45 3-deckers, making a saving in favour of the shields as 15 to 1.

The expense, however, may not be the greatest consideration. Our great difficulty in time of war will be to find men; therefore the saving of men here obtained will be a most important point. Why should we in the navy require the same manual labour to work the guns that we did in Nelson's time, when, in every trade and profession, such an enormous amount of labour is saved by mechanical appliances?

Having gone through my various plans of these shield-ships, I will briefly state the mode in which I would organise a force of these ships for our national defence. In these days of electric telegraph and motive power, intelligence of any hostile demonstration on our coast can be conveyed in a few seconds, and, on receiving the intelligence, floating bodies can be moved to any point at a certain speed in a given time. We know that steamers are built to run to New York in a given number of hours; that contracts are daily entered into for vessels to average a certain speed; why cannot we build vessels to traverse the shores of Great Britain at a given average speed? I would then, for our national defences, propose to have five of these shield-ships at Spithead, five at Plymouth, and five at the Nore, assisted by the 150 gun-boats which we already have; direct telegraph communication between these forces, the whole coast, and the Government.

These iron ships being able to move at the rate of 12 miles an hour, I think it would be a bold invader (even if our seagoing fleet were called away) who would attempt a landing with these 15 shield-ships and a musquito fleet of gunboats ready to concentrate their powers on him while in the confusion of landing; these 15 ships being able to cope with 45 sail of the present line-of-battle ships. Rafts, as proposed by me in the pamphlet alluded to, would also greatly assist in preventing a landing.

My adoption of this shield to land coast defences I will not now dwell upon, but will reserve it for a future period, as I fear that I have already trespassed too long on your patience. I will, however, remark that the same saving of space, manual labour, and expense, is obtained with regard to a fort as to a ship.

Before quitting my subject, I must, however, without mentioning names, express my gratitude and thanks to those by whose generous aid I have been able thus far to carry out my plans. The experiments which I hope eventually will be made on my shield at Shoeburyness (although much time has already elapsed) will bring my humble efforts to a certain test, and, although I would not speak too confidently, I am not without some grounds for my hope of success.

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I have said I would not mention names, but I am inclined to depart from my intention, in order to do honour to the dead. Mr. Brunel, when in 1855 I showed him my shot-proof raft and shield, most liberally informed me that he had himself been planning shot-proof light draft vessels for service against the Russian forts; but acknowledged that I had hit upon the right thing, and that he should think no more of his own plans. He then gave me his valuable assistance, allowed his draughtsman to draw the plans of my shot-proof raft, and with his well-known generosity declined to receive from me any remuneration. His remark to me was "Go on, persevere; you only require a breech-loader to make your shield perfect."

On Sir William Armstrong's gun coming out I remembered Mr. Brunel's expression, and with a fresh impulse exerted all my energies to bring out this invention.

Now that other nations are building iron-coated ships, we cannot stop. In future our fleets must fight in armour; and supremacy afloat must depend henceforth on superior ability to produce the new ships required.

The first outlay for iron-coated ships will no doubt be enormous; but, looking to the future, and at the great strides we are making in rifled cannon and in motive power, the reconstruction of the *large* ships of fleets which decide the fate of nations, though a question with regard to the time of full accomplishment, is inevitable. Three-deckers and stationary guns on the present system of fortifications for coast defences will become obsolete, and we shall look upon them as we now do upon the old stage-coach, which is only used when we can get nothing better. The most economical ship will be that which is the most invulnerable and the most durable.

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Friday, July 13th, 1860.

Gen. SIR JOHN F. BURGOYNE, Bart., R.E., G.C.B., in the Chair.

THE DEFENCE OF LONDON,

By Colonel SHAFTO ADAIR, F.R.S., A.D.C. to the Queen.

THE occasion on which I am permitted to address this meeting is so peculiar that, before proceeding to the technical questions which will arise, I think it will not be inopportune to remark on the reasons that have called us together. The Report of the Royal Commission on the National Defences is already familiar to every one present, as it will be to the entire population of the empire; and to all who, in every land, take an abiding interest in the maintenance of the British dignity, security, and renown. But when the Report of the Commissioners was published, there was an omission on one point of highest interest, but not the less capable of a most satisfactory and clear explanation; namely, the absence of any allusion to the defence of London. And, in truth, if the question of the defence of London had been connected simply with a military arrangement proposed by the Commission, I should not, on this occasion, have intruded my opinions, or have impugned the deductions of soldiers, than whom none are more competent to propose measures the most desirable for the military security of this country. But, inasmuch as the defence of London trenches on a larger question than that raised in the discussion of warlike preparation, and is too extensive a subject to be covered by the instructions of that Commission, I have thought, and the Council of this Institution have been pleased to sanction the idea that I entertained, that it would not be altogether inappropriate for one, albeit not a professional soldier, to enter on a subject which, although mainly embracing military considerations, yet in large proportion was to be weighed and judged in dependence upon the exertions, the sacrifices, and the labours of the population at large. Therefore it is that, having examined with much care and with exceeding admiration the opinions of the distinguished soldiers who have elaborated the plans set forth in the Report of the Commission of Defence, I desire to be excused of rashness in taking up the question where they have left it, in accordance with the terms and spirit of their instructions, and in bringing forward for public discussion such ideas as have occurred to me with reference to the defences of the metropolis. And since I shall not have time on this occasion to detail at length the reasons which lead me to particular conclusions with respect to any threatened attack upon London, I must request you to admit certain assumptions which I have advocated, and I hope justified here, and at other times, but which I have not now the opportunity to set forth at length. Let it then be assumed that the command of the seas has, for a season, passed from us; let it be assumed that an enemy has landed in

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force, prepared to take the alternative routes by which the metropolis may be reached. For, indeed, it seems to be generally believed that a march on the metropolis would be the special object of an invading force. But I may detain you for one moment by referring to the plan before me, in which I have traced in shaded divisions, in supplement of that oral explanation which I am compelled to postpone, the strategic justification of my belief that specific and well-ascertained routes must be adopted by an enemy marching on the capital. I find on the south coast of England three objective points of attack—Dover, Portsmouth, and Plymouth. I have given my reasons in my lecture on the defence of Portsmouth, for asserting that it is perfectly possible to surround these objective points of attack with districts of defence, such as may compel an invader to choose the routes interposed between the borders of these well-defined districts; and I have also pointed out the districts in other parts of England which would be liable to incursions of diversion, as they may be called, in order to draw off and distract the movements of the corps assigned for their defence from acting in repulse of the main attack which would be precipitated on the metropolis. Assuming, therefore, that London is the point at which the attack is directed—that the Portsmouth, the Plymouth, and the Dover districts furnish each its contingent of defence, which render it difficult, if not dangerous, for an invading force to engage in direct battle operations within their limits, there are evident points of disembarcation eastward and westward of the central fortress, which are precisely such as would be selected by an enemy who was determined on fighting battles of manœuvre. Landing to the eastward and westward of Portsmouth, they would soon find themselves in a district adapted to the tactics of practical warfare to a degree scarcely to be found in any other part of England. Manœuvring to the northward, the valley of the Thames is within a few marches. It is especially suited to the purposes of an invading force, first, because the rich district would support the invader's troops, and the Thames would give an easy mode of bringing up those indispensable stores which encumber and delay the advance of an army so much. And there is another reason which I will add, that, inasmuch as an enemy advancing on the capital from the south-east would be observed by the forces garrisoned at Dover, would be watched on the flank by the reserves within the lines at Chatham, and would also have to hew a desperate way through the eight difficult passes of the North Downs, the longer route would be adopted as the best suited on the whole to an aggressive strategy based on rapidity of advance, exaggeration of strength, and superiority of tactics.

In the progress, then, of this hypothetic invasion, it may be assumed that a great battle has been fought with or without decisive success, as the case may be, on the one part or on the other, but that the invader after this battle is still in sufficient force and sufficient heart to present himself before London. Presenting himself before London, I see no reason for doubting the issue, whatever the result of the previous conflict may have been; and it is my duty this day to give my reasons for that opinion.

Several plans have been suggested for the defence of London, but there is one fatal deficiency common to them all—the want of confidence in the inhabitants of the capital to achieve their own safety. Strategic points

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are selected without much certain reference to their individual value, as if the question was of studding a Flemish frontier with fortresses, where the soldier should be everything, and the citizen nothing. In this system I cannot but see the rejection of a mighty element of strength and safety; for in invasion, the place for the trained soldier is in the army of manœuvre, and of the citizen in the army of reserve. One plan has the authority of great names, of soldiers of large experience and military knowlege, well and honourably known to the ranks of the British Army, which consists in placing strong remote forts at intervals around the metropolis. This system has found much favour; but I confess my inability to assent to the proposition upon which it is based. I think there is, first of all, this great danger, that, when defence is based on remote points, if the interval between those points, which it would be exceedingly difficult to guard in proportion to the importance of the points themselves, is once penetrated, all would be considered to be lost. Now, I repeat again, that, whatever the result of any battle, London, if properly organised, has no reason to be discouraged; for, in my deliberate judgment, looking over the neighbouring and adjacent country carefully, considering the temper of her people and her power of organisation, I dare affirm that London is naturally the strongest capital in Europe. My ground for this opinion shall be briefly detailed. If the topographical circumstances of London be reviewed, it will be remembered that the capital is formed on a parallelogram, the northern side whereof is drawn along the ridges of the Highgate and Hampstead Hills, sinking into the great western plain at Harrow; and that the southern line passes over Shooter's Hill (speaking simply of the London district) to the bend of the Thames, which is guarded by Kingston, Richmond, and Brentford. The east approaches are covered on the north side of the Thames by the marshes of the Lea, on the south by the marshes lying to the eastward of Woolwich, considered apart from the mass of Shooter's Hill. To the west, in the valley of the Thames, lies the most difficult portion of the London district to guard, and the one against which, on my hypothesis, the whole strength of an invading force would be hurled. That point, therefore, is one, and that line is one, that it especially behoves us to regard and to defend. And, when I said that London was the strongest capital in Europe in its natural advantages, I referred especially to the impunity which may be secured to London from that agent which produces so terrible an effect on the population of beleaguered cities; I speak of the harassing and dispiriting effects of the continual stroke of vertical fire; I speak of the misery that arises to populations driven from a quarter exposed to the enemy's fire into another already overcrowded; I speak of the growing accumulation of wounded and of sick, who are crowded in the time of such calamities in vast numbers in hospitals; and I conclude that, from the conformation of London, it is above all other capitals most easily defended from such a scourge. For, to neutralize the unbearable evils of a fire so terrible, the one and the secure means is to render bombardment impracticable, by keeping at a safe distance the batteries that vomit forth their host of plagues.

I may say once for all, that my principal design in encircling London with forts which are not of a capacity too great, or of too intricate detail for the occupation of troops of reserve, at as close a distance as safety from

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vertical fire will allow—the reasons for my preference of this distribution of force to the employment of large forts at a distance—are these: I do not wish London to remain in a silent anxiety endeavouring to ascertain how the battle goes from the rise or fall of the distant cannonade; I do not desire that London should hang in suspense on the chances of a remote struggle. The defence of London should be bound up intimately with the spirit and the heart of her people; I desire that each cannon shot and each volley should raise her spirit to a higher pitch, and brace the nerve of her defenders to efforts each greater than its preceding one, until the supreme and conquering charge crown the conflict. Let her know the extent of the defence of which she is capable, that she may not know, if that defence be not prolonged, the extent of the evil to be endured.

With regard to the trace, that is a matter, of course, open to future suggestion; but, generally, and, considering the quality both for attack and defence of the troops we should have to deal with, and the nature of the assault *de vive force*, and of the resistance by musketry or carronade, I should say that, where the works are of the more important character, they should be as much as possible on a polygonal trace, with a redoubt *en caponnière*. Where the works are of a less decisive trace, there I should propose to take modifications of the old bastion system.

The armaments should be of mixed calibres; one-third of 8-inch guns, one-third of 32-pounders, and one-third of 32-pounder carronades, in order to obtain by the union of the 8-inch and the 32-pounders an identity of charge, and by the union of the two qualities of 32's an identity of projectile, and consequently greater simplicity. I am also enabled thereby to diminish the strength of the gun detachments. If the whole of the guns were of the same calibre, the detachments would require to be so strong that they must draw enormously and disproportionately on our resources: neither would they be suitable for all the cases that might arise, because, inasmuch as these forts are rather works of occasion, so to speak, than works designed to maintain a long siege, an attack would probably be of a nature that would occasionally require a proportion of ordnance handier and more quickly managed than the 8-inch on a traversing platform, or than even a 32-pounder on a garrison-carriage; and therefore the carronade is introduced to resist these attacks.

Commencing from the eastward, I propose, after the example of Alfred, to inundate the valley of the Lea from Tottenham to the Thames. Beyond this inundation I project a star fort on the high ground at Barking, nearly resting on the inundation, which would cross its fires with a fort protecting the access from the Eastern Counties Railway, and, at the same time, keep down any attempt to molest Woolwich from the low-lying ground between Barking and the river. Fort Barking should be armed with thirty guns. The garrison details will be given in the Appendix (A).

Now, since London is shielded on the south side by the hills of Kent and Surrey, and on the north side by the hills of Middlesex, it will be seen that, if we can detain an advancing enemy on the southern and northern slopes respectively, a very large power of mischief is withdrawn. I have, therefore, on the plan, drawn the line of works with which I propose to protect the northern, eastern, and southern side, and also a line of works

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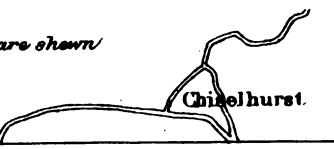
Note. *Railways in progress are shewn thus* ------



Bromley

J.R.Jobbins

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and batteries with which I would close the entrance to London from the westward, by the approaches in the Valley of the Thames.

Passing from this fort of which I have spoken, I proceed to a similar one. Fort Stratford, of 30 guns, resting on the Eastern Counties Railway. I shall hereafter point out the advantages that I propose to derive from the inner line of railway which traverses London from East Woolwich to North Woolwich; and I would here remark, that many of these works have been placed, especially on the south side, so that their rear will be covered and their flanks commanded by the artillery fire that may be projected by aid of this circular railway. Passing to the north-west, we come to Low Leyton, where the Leyton Redoubt of 30 guns rests on the River Lea, and on the inundation. The ditches are supplied from the waters of that river, and it crosses its fire with Fort Stratford and with Fort Stamford of 20 guns on Clapton Common. Fort Stamford is placed on the low ground whence the Stamford plateau rises from the marshes, in order that the defence of the Eastern Lines may thus be completed, and also a powerful fire lent in aid of Fort Hornsey, of 20 guns, which I have placed in such a position as to cover the reservoirs through which London draws from the springs of the New River a large proportion of its water supply.

I now come to the difficult point of the occupation of the ground about Highgate. Passing along the plain to the north-westward, it will be observed that on the left the spurs of the Highgate range project themselves into the country north-east, terminated by a hill overhanging the railway, and called Mount Pleasant, in the south-east direction, and by Muswell Hill on the east. With all an artilleryman's distrust of a very high elevation and excessive command, I doubted whether it were safe to draw defensive constructions close to the crest of the hill; but, bearing always in mind how necessary it is to protect London from the scourge of vertical fire, the better course appeared to advance, along the axes of these hills, two semi-elliptical works, Forts Muswell and Mount Pleasant, of 25 and 20 guns respectively, of a trace determined by the ground, to cross their fire, be connected by earthworks, and thus detain the enemy at a safe distance. Passing from Highgate, the ground forms a natural *glacis* to the northward, sloping upwards to Hampstead Heath. Hampstead Heath is a very favourable position for defence, and must be carefully secured by double lines of earthworks.

In considering the treatment of Hampstead, I am indebted to the skill of Lieut.-Colonel Alcock; R.E. Middlesex Militia, for suggestions on fortifying that hill. He observes very truly, that on the upper summit is a space for a work of 15 guns, giving extensive command over the valleys radiating from that point, and that the fire of that position may be combined with that on a lower hill called Child's Hill Redoubt, and armed with 30 guns, marked as a semi-circular work on the plan. Those combined works are of importance from their position, and capable of prolonged defence, and are designated the Hampstead and Child's Hill Redoubts. A country is now entered upon especially suited for two purposes: for manœuvre by skirmishing in force, and with heavy reserves; and secondly, for fighting a battle with field artillery. It strikingly resembles the famous field of Bautzen, which was the scene of a protracted artillery battle, and contested with such skill on the part of the Allies that they were enabled to

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withdraw every gun at the conclusion, to the astonishment of the Emperor Napoleon. As the slope of Hampstead is descended towards the Edgeware Road, in front lie the Brent Reservoirs. In conformity with the obligation which I have imposed upon myself of protecting reservoirs wherever possible, I propose to construct at the north-east angle above the Brent Reservoirs the Brent Redoubt, an irregular work of 30 guns, which should protect that basin.

The most difficult district, so far as regards a battle of manœuvre, is now approached. Between the flat-topped hill rising immediately above the Brent Reservoirs and the Harrow Road an eminence will be observed, culminating in Wembley Park. On that point I would construct Fort Wembley of 30 guns, a work which shall give a reverse fire, if the enemy should penetrate athwart or pass round either point of the Brent Reservoirs, and also sweep the country to the north-east, and in front of the separate chain of field works intended to cover Harrow. It should also be kept in communication with the next and most remarkable point in the western neighbourhood of London, where the undulating range terminates in a bluff crowned by Horsington Wood. It is a very strong position, about two miles from Harrow, and closes the whole of the level ground on the north side of the river Brent, and, in fact, observes the country to the bridge-head at Brentford. The southern face is of a steep and almost scarped character. It has capacity on the summit for the construction of a large fort, and I think should be used as a depôt, and considered the right point of *appui*, facing outwards to the lines of the western defence. The country at the foot is marshy, and is susceptible of inundation, being traversed by the waters of the Brent, and is partially covered by the Grand Junction and Paddington Canals. Now, it may always be observed that in defensive warfare very great use can be made of inundations, and that they are invariably turned to the profit of those who know the country, and who can direct them at pleasure. I should, therefore, taking Horsington Hill as a depôt, and as a main point, the key in fact to the position, arm that position more heavily than any other, and 80 guns should be assigned to Fort Horsington. Fort Greenford, placed within the loop of the Brent, would require 60 guns. Fort Ealing, projected on the flat in front of that town, should mount 60 guns, while the line of fire would be continued by four pairs of batteries armed respectively with 10 guns to the bridge-head at Brentford. Passing through the flat country, where the works, nearly as far as Ealing, are defended by water, and thence by the ordinary appliances of engineering skill, the lines reach Brentford. Brentford is protected by a bridge-head mounting 20 guns, as is Richmond Bridge by 20 guns. Kingston, lying on an exposed salient, is covered by a bridge-head with a strong bastion trace, and mounts 40 guns. For if the assumption be correct that the weight of invading war would be brought on the west of London, it is important to guard this point with as heavy a mass of fire as possible. In the rear, on the slope of the hill above Ham Common, Fort Richmond, a strong work of 20 guns, planted at the apex of the angle formed by the western and southern sides of Richmond Park, would connect the western and southern lines of defence.

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Defence of Harrow.

And at this portion of the London lines I turn to the special defence of Harrow. The position is too valuable in the military point of view, and the ground too highly placed, in the national estimation, to be left in peril of foreign occupation, by being excluded from the metropolitan system of defence, however difficult the defence may be. The long slope of Harrow, projected nearly at right angles from the north-western angle of the London lines, rises in a continuous ascent for a mile and a quarter to the highest point crowned by the parish church. The flanks of the hill gradually increase in steepness, until the rapid slope of the north-western face projects boldly, overlooking the plain of the Thames to the distant hills of Surrey and of Berkshire, and overtopping the nearer heights of Stanmore to the north-east.

The most appropriate system for the defence of Harrow, on the special ground of the military value and of the national character of the spot, will be by batteries, and not by works of construction on a regular trace. For works casemated or otherwise of a permanent character could not be constructed without obliterating the special distinction of the hill, as consecrated to national education. But this strong post of vantage may not be the less efficiently secured.

The formula of defence is this : heavy earthen batteries, loopholed and stockaded posts, and an extensive system of rifle trenches. The earthern batteries should have no great command, but have an uniform mutual relation of defence. The position of the batteries should be determined by a contouring line, to be drawn at such an elevation on the slope as would give an angle of depression of 4° on a point distant 700 yards from the foot of the rising ground on which the battery is to be placed. The general line of the zone of artillery fire would commence on the Greenford Road, one mile from Harrow, and passing below the south-western shoulder of the hill, would sweep to the north of Roxeth, and thence to the junction of the Kenton Road, round the northern face of the hill. The line would follow the hollows of the hill until it reached the cross road connecting the two approaches from London, and passing to the westward complete the circuit. The right and left rear would be connected by field-works with Fort Wembley and Fort Horsington.

For this line of defence nine pairs of heavy batteries, of the construction of those on the Hilsea lines at Portsmouth, would suffice; they should be armed with twenty guns, each pair, and be determined in position by the re-entering angles or loops of the contouring line—for the southern and western faces six batteries; for the eastern face six batteries, and the northern front should be formidable with six batteries, of which two should be advanced on either flank, to give a decisive check by flanking fire to attacks on the lateral fronts.

The rear of these batteries should be closed by strong musketry redoubts, which should in turn be open to the rear to fire from loopholed houses and stockaded posts. And from battery to battery, and along every advantageous slope of ground, should be traced rifle trenches formed by

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excavation, with the earth thrown to the front, as *glacis*, and not as *parapet*.*

Every position would thus be threatened in turn if it were necessary to withdraw the defenders from the lower levels. Finally, the Volunteer Corps of Harrow should have this defence specially assigned as its duty.

I now proceed to treat of the southern lines of defence, whereon I place the works, not symmetrically indeed, nor at equal intervals, but, as I have throughout, according to the circumstances of the ground, determining the projection of their face as they may be required to sweep any particular point of approach with their fire. Now, those who recently attended the practice of the Volunteer Rifles on Wimbledon Common will remember how rapidly the ground falls in front of that position. Since it is necessary to occupy that plateau, it appears desirable that a work to be called Fort Wimbledon should be constructed in the immediate neighbourhood of the present rifle ground, which would answer all the conditions proposed, namely, sweeping and searching the ground in front and flank with 40 guns, and keeping an enemy at a sufficient distance from the inner district, liable to insult from vertical fire. From Wimbledon, following the southern slope of the hill, the very remarkable ridge which divides the waters of the Wandle from the Sydenham Plateau is reached. On the level ground immediately above Tooting Common, on the ascent from the village below, I should propose to place Tooting Redoubt, another substantive work of 30 guns, to be kept in connexion with Fort Wimbledon by earthworks distributed through the plain, across the course of the Wandle. The ground at many of those points is remarkably strong. And there, again, a water defence may be adopted very successfully.

From Tooting, following the indications given by the slopes of the ground, we arrive at the Beulah Redoubt, an irregular work of 30 guns, which will be seen to the north-west of Beulah Spa. This work is adapted to the character of the eminence which it crowns, and is designed to maintain a communication with an advanced work, the Anerley Redoubt, of 20 guns, in front of the Crystal Palace, of an irregular shape, resting partly on the Railway, and partly on the Anerley Ponds.

We have now lying in front of us the great plain of Kent. From these heights the general line of ground is most clearly and distinctly to be traced, and the approaches of an enemy calculated. I should therefore across the valley on the other side of the Ravensbourne river, on a gentle slope which rises at a distance of one mile and a half in an air line from the Crystal Palace, place Fort Ravensbourne, a substantive work of 50 guns; and the line of defence would be closed by Fort Woolwich, a work of 80 guns, with its rear resting on the Dover Road, in the loop of the road near Woolwich Common. With regard to fortifying Shooter's Hill, that point I have not taken into consideration. The occupation of Shooter's Hill is a matter of high engineering moment and skill, and would require a very considerable outlay. It must, in fact, be a fortress of itself, and therefore does not enter within the scope of these suggestions.

* An illustration of the rifle trenches may be found in the trace of the ascending sap at the siege of Burgos.

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I would request the meeting to bear this in mind, that the works I have pointed out are not the only works I desire to construct. These are the permanent works which it is essential to construct, and the fire of which it is necessary to determine. But the intervals must be consolidated by such field works as can be thrown up with comparatively little labour, and would by their cover enable the troops detailed to maintain the musketry fire which is necessary for a complete defence. Therefore I differ from the advocates of the *enceinte continue* at Paris and elsewhere. I propose to leave only the forts *en permanence*, but in time of necessity to connect them by means of field works.

It is a very just objection, that the requisite guns and troops are seldom mentioned in detail of plans; and, at the risk of having the calculations disproved, and in the design of submitting them to critical analysis, I commence by the calculation that 870 guns will be a sufficient armament for these works, exclusive of the defence of Harrow, which must be special, as has been already shown. From the combination of qualities of ordnance which I propose, the strength of the artillery detachments may very materially be kept down, as may be reasonably borne in mind in calculating the strength of artillery required for the service of the London lines; and, inasmuch as the general defence of the lines of London would not be a matter of siege, and of protracted firing and attack, the service can be carried on with fewer reliefs than in a garrison which had to resist on a front of attack assaulted according to the rules of art. Therefore, it appears to me, that seven men per gun would furnish a standing garrison sufficient to justify us in undertaking the defence of the works most likely to be attacked *de vive force*. Perhaps the higher proportion should be preserved for such works as from their importance might be more formally attacked. The infantry defence may be calculated on a low scale at 10 men per gun, being intended simply to occupy the works while operations are going on, and their number must be inconsiderable, and should be inconsiderable on this principle—that we are occupying works which are to be only temporary obstacles, and which should be so constructed as to allow every disposable man to be placed in line of battle, and available under the hand of the supreme military authority.

Now, having surrounded London with works, the question arises, what are the resources for defence? The assumption which I have always insisted upon is, that the primary defence of England should be a defence by local forces specially trained for the protection of a particular district, wheresover the attack may fall, in order that our limited manœuvring force may be available in every direction in which it is required. Thinking thus, I hold with regard to the metropolis, that the metropolis should be prepared to stand or fall by its own substantive defence, and not in consequence of any operations elsewhere. We know what a gallant, and ready, and available spirit has arisen throughout the country in development of the volunteer movement. We see in these levies the earnest of a true soldier-like, manly, British determination to do their duty. They show in their organisation and by their bearing, the consciousness that they have undertaken a duty which the country required should be performed, but which could not be discharged by existing means. We know what sacrifices many in their

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ranks have made, and those especially to whom the time given to their occupations is valuable, and whose leisure hours have also been placed, without fee or reward, at the service of the State. It has been a matter of some little difficulty to arrange the proportions of these volunteer forces that we may expect to draw from the general population. I have found the greatest assistance from the accurate statistical tables prepared by Lieutenant-Colonel Kennedy, in his valuable memoir on "National Defensive Measures, their Necessity, Description, Organisation, and Cost." To him I am indebted for suggestions showing how the volunteer forces may best be disposed in proportion to the military demands on the population. I have, therefore, adopting his principle, placed the masses of volunteers in such positions as they might advantageously occupy in the event of a call for their services. I have not attempted to distribute the general body by regiments, which would complicate the plan, but, observing the calculated density of the population, I have assigned to them alarm-posts in their respective localities, which would be points whereon the regiments, brigades, or divisions would form upon the first alarm. The corps would then be available in the direction for any special purpose, and would thus be prepared for any movement. The tabular arrangement is shown in the Appendix B.

It is evident, as has been shown, that this question is removed beyond the province of purely military speculation. It should be maturely considered, whether the volunteer regiments, armed, drilled, and disciplined, may not have an enlarged scope given to their organisation and some additional duties assigned to them, in the interest of their special service, which are not ordinarily devolved on regular troops, or on troops in the field. For instance, as I have shown, one great evil to be dreaded is the vertical fire that the enemy would endeavour to pour on the metropolis, with which he would hope to alarm the population, and, hence through their fears, to extort a capitulation of London. Now, in the firm confidence that I have in the power of organisation enjoyed by the English people, and in their present readiness to adopt any sound suggestion, and their firmness in carrying it out, I maintain that even this evil, so awful to contemplate, may be modified, minimised, nay, reckoned as an ordinary incident of battle.

It is always satisfactory to draw some instruction from the occurrences of former times under similar circumstances, and with a population of identical character. For it would almost seem as if the precedents of the reign of the great Queen, in anticipation of the Spanish invasion, were, with other glorious incidents, to be repeated in these later days. Now, it is very remarkable that in the accounts of the armament of Elizabeth to resist the invasion, a proportion of artificers is always combined with every armed body. There are pioneers and artificers of all trades, wheelwrights, carpenters, blacksmiths, all specified in particular and accurate proportions, detailed to accompany every body of armed men. Let, then, every volunteer force embodied under a regimental colonel or field officer have a volunteer engineer corps attached. Thus an opportunity would arise of drawing on the valuable class of men to be found among the steady resolute artizans of the metropolis. And I believe that such an organisation would be acceptable to the body of Civil

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Engineers. That is one preparation. I would suggest, also, that to guard against the ill effect produced by working on the fears of the population through the threat of laying districts and suburbs in ashes, one fire brigade, with engine and horses, be attached to every district, and planted at every alarm post. Supposing, then, that any portion of the metropolis was on fire, it should be the special duty of the Engineer volunteer officer commanding at that point to hasten with a proportion of volunteer Sappers to the conflagration, extinguish the fire, and take such measures as might be necessary. By thus distributing the volunteer regiments or corps each to its defined district, and by assigning to each a special object and duty, confidence would be given to the people, and the dangers and terrors of a bombardment would be neutralised and dispelled by a simple and timely arrangement. If the people do not clearly perceive the manner in which they are to be defended, and by what arrangement their security is to be ensured, panic will arise, confusion will double every difficulty, and the military authorities will have to deal over and over again with the only military difficulty worth speaking of in England, that is, the process of clearing the front of non-combatants, to meet which special provision must be made. If the front be cleared of non-combatants the English soldiers will fight as they always have fought. But we must be prepared against the danger not only of reverses in the field, but against that greater danger which arises from the panics of unarmed and helpless multitudes in towns. And to combat this peril I make a special provision. I spoke of the difficulty of clearing the front of non-combatants. I believe that the terror which an enemy would hope to generate in the confused masses, by the approach of an invading army, would be held to be one of the most powerful weapons of invasion. This expectation it is our duty to dispel. I may be supposed to theorise, to estimate too lightly, or even to overlook difficulties which must inevitably arise in dealing with large masses of people; but, considering the perfection at which our railway communications have arrived, the speedy means which are enjoyed of connecting one part of the country with another, it is doubtless feasible, when one front of London is invested (for it is scarcely possible to suppose that London can ever be entirely invested), by due organisation to pass the whole of the non-combatants from the front attacked, through London, to the rear, into districts, towns, and places prepared for their reception, on which they shall be directed by the aid of the wide-spreading system of railways, which, radiating from London, traverses England in every direction. And so soon as those whom we desire to withdraw from the horrors and miseries of war should be conveyed far from the scene of conflict, there would be clear space for those who would alone remain in the front to defend their hearths and homes. I make this suggestion confidently, and believe it to be perfectly practicable. I think, Sir, you who saw to what extent the pervasive organisation of England was carried, in contending in the depth of a severe winter with the Irish famine, will have that confidence in the national power of combination to admit that such a plan is neither rash in conception nor impracticable in detail.

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And for this service the admirable bodies of Metropolitan and City police might be trained. Their familiarity with the condition and daily life of all classes would give them the means of effectually putting in motion the inert mass, which would not be manageable under other agencies. To them also would belong the duty of maintaining the peace and security of the metropolis, certain to be troubled by the ill-disposed classes, who always expect plunder and license in periods of national peril.

Let us now consider the defence of London with an enemy at its gates. It is fortunate for those who entertain my opinion, that London deserves an unhesitating and protracted defence, that we already possess, as matter of history, the account of the successful defence, or rather of the relief, of an almost open town under more difficult circumstances than could probably be found twice in the annals of war. I allude to that great feat of arms performed by the Emperor Napoleon when he relieved Dresden, overmatched as he was in numbers, overmatched as he was in guns, and overmatched as he must have been but for his genius, his resolution, and the energy of his soldiers—in the moral power that the enemy brought to bear against him in the campaign of liberation. If the enemy, having pierced the line of works I have detailed, were in possession of the heights of London, and thence looked down, with the intention of fighting their way into its streets, I say the defenders of London would not be in so bad a plight as St. Cyr was, when, with his 20,000 men, he threw himself into Dresden, knowing that the Emperor would come to his aid; and how gloriously the Emperor did assist him, the historian has recorded as an example of what may be done in the defence of towns in all times. Dresden was almost an open town, merely surrounded by shattered walls, so imperfect in its fortifications that it was requisite to strengthen it by five large redoubts. In this Dresden 136,000 men held at bay and repulsed 166,000 men with 500 guns. The front of that battle extended for six miles and a half; but, again, the French Emperor was equal to the occasion, his soldiers seconded him, and the result was the disastrous retreat and rout of the Allies. Therefore it is that I say, whatever might be the condition of London, hemmed in as she might be by the masses of an invading army, there can exist no reason for despair, no reasonable excuse for abandoning the capital, no apology for deeming that it would be wise to purchase with our gold that which we could not defend with our swords.

I do not wish to speak with the exaggerated feeling that may arise when we consider with how great a calamity this nation might be threatened; I desire simply to deal with the plain mechanism of military resistance; I mean to prove what resistance, by works of construction, may be prepared; and I indicate the powerful means of resistance which may be anticipated from the support of your people. And I have endeavoured to show (by clearing thoroughly and decisively the field for the exertions of fighting soldiers), that if the disastrous event of the leaguer of London should ever occur, it may safely be left to history to say that the Russians were obliged to abandon and to burn Moscow in their distress, but the English remained and fought on their own ground.

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Now, with regard to those details of interior defence, to which I have partially alluded, I speak of the zone of railways, which, beginning at North Woolwich, penetrates and surrounds the central portion of the metropolis on either bank, even to West Woolwich. I divide this zone into artillery districts. It is a point which I have discussed upon former occasions, and the distribution will be thus: I would make one artillery district from North Woolwich to the Stratford Station; a second artillery district should extend from the Stratford Station to the West London Junction; from the West London Junction to the banks of the Thames should give a third; a fourth should be drawn from thence to Clapham Station; from Clapham Station to Norwood Hill would form a fifth; and from Norwood Hill to Woolwich would complete the zone of artillery defence encircling central London with a second rampart. Now it is not that a railway is in its construction powerful for defence, for, in fact it may rather be called a line of movement than a line of defence, but that I would place on this curved trace of railway, guns moveable from point to point as occasion might arise. The stations projecting from the railway might be called points of emergence, on which to direct such field guns, stores, or troops, as might be required on a sudden change of front, or increase of attack. Such an adaptation is feasible, and adds, moreover, materially to the strength of those works near which the zone passes.

There is another point on which I would dwell in respect of the volunteer system. Admitting the axiom, that the standing defence of England is that by local forces acquainted with the particular districts, it is essential that volunteer corps should be acquainted with not only their own district and alarm-posts, but also with the nature of the country which might lie in their front when once they had quitted the suburbs of the metropolis. I can imagine cases (but it is scarcely worth while to particularise) in which the defence of London would be conducted with much greater success by soldiers accustomed to a particular district than by those who are strangers to the locality, and who had merely the ordinary rules of military service for their guidance. The local features of London, and especially of Western London, are very peculiar. There are large and well-defined districts broken up into manageable divisions of defence by the great thoroughfares that penetrate the capital. For instance, one side of our great thoroughfares might be occupied in force, and a defence developed against an enemy attempting to penetrate into the interior. It would, therefore, be advisable that to every great division, or independent corps of volunteers, field-guns should be attached, for the purpose of ultimate defence; because I hold that under no circumstances are we justified in capitulating for London. I repeat my belief, that we can rapidly and easily, with our organisation, remove the non-combatants from the danger in which they would be placed, and in which they would naturally look for sympathy and protection; and then, wherever the weight of attack may fall, I say we shall have no reason to despond for the fate of London.

And perhaps I dwell more on this subject because I am aware how little the English determination has been understood elsewhere. Because we do not proclaim without ceasing, a resolution to do that which falls to our lot in the shape of duty, it is often supposed that we have either lost

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the power, or at least the spirit, which cares for the performance of great things. It is well that it should be known, that Englishmen carefully and deliberately adopt the resolution, that London is not to be taken; that we will neither hear in London of the removal of our Government, our Courts, or our Parliament; nor of the ransom of the City.

I would briefly remark here, that the zone of defence passing through these forts is about fifty miles. It is no very great extent to fill in, or make complete in the intervals between the forts, by field-works. The zone of radiation of fire covers 75 miles. And on this projection there are but three points, not included within a circle traced on a radius of one mile from a work, or, which is equivalent, from a point on a railway, at which guns might be placed in battery. These breaks measure respectively 700 and 1,000 yards. Consequently field-works would be covered during construction by the fire of forts and redoubts, direct or vertical. The zeal of the population, when appropriately directed, and when organised for the execution of well-considered plans, would cover the intervals of these works with such means of resistance as would enable us to justify the great promise that none need hesitate to make on behalf of the people of London. I am firmly and unalterably convinced of this fact, that so strong is London in its natural circumstances, rightly understood, for the special purpose of a judicious defence, that the greatest military reputation might be safely perilled on the successful defence of this capital, if only one point be conceded; namely, that we organise, be prepared, and be wise in time.

And in reviewing the history of great national crises there is an epoch which has been forcibly described by the great historian his country has so recently lost. He speaks of people resembling us nearly in their national character, like us, men of the sea, and like us, men who did not shrink from warfare on land. When the Dutch, the men of the Seven United Provinces, in their great national agony and distress, were almost overpowered by the great military monarchy of France, what was the resolution they adopted? Not to ransom their capital, in order that they might linger for a time on the marts of traffic, where whilst free they had been placed among the merchant princes of Europe; not to abandon the capital, and to betake themselves to some quiet region until the storm be overpast; but they said, "Either the country is to be held wholly and unconditionally by a free people, or it is no fit dwelling-place for them." They said, "Rather give our fields back to the salt sea, and the cities that we have wrested from the Spaniards to the monsters of the deep, than remain dishonoured in our own land." They were prepared, as the historian tells, in another clime to found new cities, and to seek new kingdoms under other constellations. But he also adds, "the men who have the courage to form these resolutions are seldom called upon to execute them." So it is with us. If we be determined, in our calm way, to declare that none shall make us afraid, and that we will hold our own, seeking to offend none, so soon as the determination is evident, and the force for defence is prepared, as has been shown full often in the history of the world, the attack is suspended, and the threatening war-cloud passes away.

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POSTSCRIPT.

SINCE this Address has been made public, objections have been taken, both in the House of Commons and elsewhere, to the proposal for a defence of London, which it may be permitted me to examine and to test.

First. The first objection is, that if the arsenals are fortified London can be more effectually protected by armies in the field than by forts.

Secondly. The second objection results from the assumption that entrenched camps are a more certain defensive resource than fortified posts or suburban works, because an entrenched camp cannot be safely neglected by an advancing enemy.

Thirdly. That forts demand a large, clear space around them, and that works round London would be encroached upon by buildings to a dangerous extent.

Fourthly. That not only would the purchase of land for the works be very expensive, but that the connecting belt of ground required to be kept clear of buildings for future field-works would add very materially to the cost.

Fifthly. That such extensive works cannot be adequately manned, especially in artillery; and that no account has been taken of the regular army, the garrison of London.

To these objections I reply briefly—

First. That by securing the arsenals from attack, the advance of an enemy is determined through the unoccupied country interposed between the principal coast-districts of defence previously referred to. To guard against this movement the interjacent space must be occupied by an army of manœuvre. But the operations of an army of manœuvre, which has no firm base whereon to retire, will not be conducted with the requisite vigour, as was the case in 1815 with the army of the Loire.

Again, while an army of manœuvre is engaged at the front, an army corps in diversion, probably from the north-east, might threaten London, and with impunity. And an advance on the northern bank of the East Thames should not be excluded from calculation; for it must not be forgotten that, in proportion to the success that may have been obtained in the fortification of the arsenals, will be the tendency to penetrate between or turn their districts and invest the capital.

Secondly. An entrenched camp is of excellent use for concentration of troops, but if it be not placed directly in the line of approach of an invading force it does not fill the function of a fortress; and if it lies directly in that line, and thus arrests his march, the probability is, in the particular case now under consideration, that more is gained to the enemy by delay which will permit the arrival of reinforcements than even by a successful assault.

The imagination is misled and confused by an imperfect analogy between the Roman Camps and those of modern warfare.

The Roman camp exhibited the tactical disposition of a Roman manœuvring force in campaign against an enemy who possessed few mathematical or precise principles of manœuvre, excepting always the captains of the Punic wars, and of the campaigns of Magna Græcia. A modern

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camp, on the contrary, represents the accidental and occasional disposition of armies of equal skill in the science of war, whereas the Roman camps were fortresses against superior weight of force; as for instance that in which Marius paused before he annihilated the Cimbri. The modern entrenched camp is but an unscientific congregation of troops, whose entrenchments are a cumbrous barrier to manœuvre, rather than a shelter against superior force.

The defeat of Braun by Frederick the Great, during his blockade of the Saxon entrenched camp at Pirna in 1756, illustrates the disadvantages of an entrenched camp of observation, and such is the design of a camp entrenched to cover London.

Thirdly. From the topographical character of London it is perfectly practicable to select positions of sufficient command to secure the works from the risk of being masked by neighbouring buildings.

In the contemplated necessity of clearing the military zone the amount of property to be sacrificed would be but trifling, and under some conditions of attack, buildings projected in advance migh tbe converted into very effective outworks.

When, also, it is remembered that the sites proposed for these works would probably be those selected by an enemy as positions for batteries whence to harass London by vertical fire, the occupation of the ground by defensive works may appear not altogether injudicious nor too costly.

Fourthly. The purchase of land would necessarily be of considerable amount, but as respects the connecting belt of land, or zone of military communication required for the construction of intermediate field-works and batteries, the quantity purchased might be relet under suitable agreements.

For it would seem that many railway companies have displayed a largeness of design in construction, a liberality in finance, and a sagacity in selection of ground adapted to the present and future requirements of their undertaking, on a larger scale than would be needed, in order to draw a permanent rampart around London, and thus to furnish a practical object and inducement to the continuous exertions of her volunteer soldiers.

Take for instance the cost and engineering difficulties of a well-known system of railways, the central line resting at either terminal point on Liverpool and Goole. The cost of that railway was £12,000,000, and the engineering difficulties were enormous. And yet the construction of that system is not reckoned among our special triumphs of engineering science, nor the capital sunk as of much account.

Lastly, it may be difficult to maintain the zeal of the Volunteer Corps unless some specific aim of their labours be pointed out. But if it be once made clear that they are designed for a specific duty, which no other troops can perform so well, and that on them a great responsibility will be cast, the immediate result will be not only to stimulate their efforts, but to add to their numbers. The consciousness of definite purpose will lend a most effectual impetus to the general spirit of enrolment.

I have not taken into specific account the regular forces quartered in the capital and its neighbourhood, for two reasons.

The precise strength of the Regular Army must always be a fluctuating

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element of calculation, whereas the Militia and the Volunteer forces should be numbered and posted to a man.

I desire also that the Army of Reserve should be habituated to consider it to be their duty to fight in positions where local knowledge and firmness are the first requisites, and to teach them that these positions must be maintained by themselves alone.

The eleven Metropolitan Regiments of Militia and the Hon. London Artillery Corps would form an available reserve. And so much of these suggestions as is well founded is applicable to every city, town, and village of the United Kingdom.

APPENDIX.

APPENDIX A.

Detail of Works.

Works.	Guns.	Gunners.	Infantry.	Works.	Guns.	Gunners.	Infantry.
A	20	140	200	K	20	200	300
B	20	140	200	L	20	200	300
C	25	175	250	L′	40	400	600
C′	20	140	200	M	20	140	200
D	15	105	150	N	40	280	400
D′	30	210	300	O	30	210	300
E	30	210	300	P	30	210	300
F	30	210	300	Q	20	140	200
G	80	560	700	R	50	350	500
G′	20	140	200	S	80	560	700
H	60	420	500	T	30	210	300
H′	10	70	100	U	30	210	300
I	60	420	500	W	30	210	300
I′	10	70	100	X	180	1,260	1,800

Total:—Works 28, Guns 1,050, Gunners 7,350, Infantry 10,500.

Cost at £1,000 per Gun, without Land, £1,050,000.

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APPENDIX B.

ESTIMATE of PROPORTION of VOLUNTEERS available within the LONDON LINES.
Extracted from Lieut.-Colonel Kennedy's Memoir.

No. I. DIVISION—LONDON LINES.

Volunteer Force should be 4-20ths of Males capable of bearing Arms.

ALARM-POSTS.	COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
	MIDDLESEX.		
	WEST DISTRICTS.		
Holland Park	1 Kensington	30,000	6,000
Belgrave Square	2 Chelsea	14,134	2,826
Grosvenor Square	3 St. George's Hanover Square	18,307	3,661
Westminster Playground	4 Westminster	16,402	3,280
Trafalgar Square	5 St. Martin in the Fields	6,160	1,232
St. James's Square	6 St. James, Westminster	9,101	1,820
		94,105	18,819
	NORTH DISTRICTS.		
Portman Square	7 Marylebone	39,424	7,884
Haverstock Hill	8 Hampstead	2,996	599
Euston Square	9 Pancras	41,739	8,347
Cattle Market	10 Islington	23,832	4,766
Hackney Common	11 Hackney	14,607	2,921
		122,598	24,517
	CENTRAL DISTRICTS.		
Russell Square	12 St. Giles	13,533	2,710
Lincoln's Inn Fields	13 Strand	11,115	2,223
Lincoln's Inn Fields	14 Holborn	11,655	2,331
Gray's Inn Square	15 Clerkenwell	16,194	3,238
Clerkenwell Green	16 St. Luke	13,514	2,702
Finsbury Square	17 East London	11,101	2,220
Middleton Square	18 West London	7,197	1,439
Smithfield	19 London City	13,983	2,798
		98,312	19,661
	EAST DISTRICTS.		
Standard Tavern	20 Shoreditch	27,314	5,463
Bethnal Green	21 Bethnal Green	22,548	4,509
London Hospital	22 Whitechapel	19,940	3,988
Victoria Park	23 St. George-in-the-East	12,094	2,418
Stepney Green	24 Stepney	27,694	5,538
Bow Common	25 Poplar	11,790	2,358
		121,380	24,274

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No. I. Division—*continued.*

ALARM-POSTS.	COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
	SURREY.		
	SOUTH DISTRICTS.		
Orchard Gardens . .	26 St. Saviour, Southwark .	8,933	1,786
,, . .	27 St. Olave, Southwark . . .	4,844	968
Leather Market . .	28 Bermondsey	12,032	2,406
Lock's Fields . .	29 St. George, Southwark . .	12,956	2,591
Surrey Zoological . .	30 Newington	16,204	3,240
Kennington Oval . .	31 Lambeth	34,831	6,966
St. Anne's Hill . .	32 Wandsworth . . .	12,691	2,538
Brunswick Square . .	33 Camberwell	13,667	2,733
Emigration Depôt . .	34 Rotherhithe	4,451	891
		120,609	24,119
	KENT.		
Greenwich Park . .	35 Greenwich	24,841	4,968
Lewisham . . .	36 Lewisham	8,709	1,741
		33,550	6,709
	Total of No. I. Division	590,554	118,099

No. II. DIVISION.—SOUTH-WESTERN LONDON LINES.

Volunteer Force should be 4-20ths of Males capable of bearing Arms.

ALARM-POSTS.	COUNTIES AND DISTRICTS.	Total Males capable of bearing Arms.	Effective Volunteers required.
	1. SURREY—exclusive of London Districts.		
Kingston . . .	47 Kingston	6,696	1,339
Richmond . . .	48 Richmond	3,976	795
	Total of No. II. Division	10,672	2,134

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No. III. Division.—Northern London Lines.

Volunteer Force should be 3-20ths of Males capable of bearing Arms.

Alarm-Posts.	Counties and Districts.	Total Males capable of bearing Arms.	Effective Volunteers required.
	6. MIDDLESEX—Exclusive of London Districts.		
Brentford	134 Brentford	10,331	1,548
Hendon	135 Hendon	3,979	594
Barnet	136 Barnet	3,655	546
Edmonton	137 Edmonton	11,324	1,698
		29,289	4,386
	7. HERTFORDSHIRE.		
Hatfield	143 Hatfield	2,125	318
Watford	145 Watford	4,700	705
	Total of No. III. Division	6,825	5,409

GRAND TOTAL.

No. I. Division	118,099
No. II. Division	2,134
No. III. Division	5,409
In All	125,642

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Friday, May 18, 1860.

Captain E. G. FISHBOURNE, R.N. C.B., in the Chair.

ON COMBINED STEAM.

By the Hon. JOHN WETHERED, Member of the American Senate.

About half a century ago, in the year 1807, after many disheartening failures which had caused nearly all of his friends to abandon him, Robert Fulton, with an indomitable spirit of perseverance, finally solved the problem that boats could be propelled by the power of steam.

Notwithstanding the establishment of the fact by the daily trips of this first successful little steamer up and down the waters of the Hudson, many years elapsed before any considerable advancement was made in steam navigation, for, even as late as 1814, seven years afterwards, there was but one steam-boat in the British empire, and she of only 69 tons' burden.

Contrast that period, within the memory of many, with what is now presented—thousands of steamers ploughing the waters of the rivers, lakes, and oceans in all parts of the world—extending the limits of commerce, developing resources, economising time, cheapening the cost of production, and consequently ameliorating the condition of mankind. Fulton did not live to see fulfilled the predictions which he had made to the President of the United States and to the Emperor Napoleon I. He died poor, because he lived before his time. The world was not prepared for a long time to see what were the clear convictions of his own mind. It affords me, however, great pleasure to say, that, when his prophecies began to be fulfilled, the American Congress, with a commendable and just liberality, voted his heirs a tract of land which secured to them a happy independence.

The subject of steam navigation in time became of so much importance that the attention of some of the most scientific and mechanical minds which the world afforded, has been directed towards improvements in the generation and application of the great motive power: boilers have been constructed with the view of bringing every particle of water, so far as practicable, into contact with the heated iron, due attention being directed to insure, if possible, a perfect circulation, so as to keep the water in contact with all parts of the heated iron. The various mechanical movements of the engine have been simplified so as to produce as little friction as possible in the moving parts of the machinery. Many suppose that the most modern-built boilers and engines are nearly perfect, and that but little remains to be done. What is called the life of a boiler lasts from five to

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seven years, and, when we see boilers of the same type repeatedly replaced, both in the Government and private service, we may conclude that no very great improvements are looked for in that direction.

The great question appears to be, What is the greatest quantity of water which can be evaporated by a pound of coal? The scientific and mechanical journals are full of reports of experiments made by our Governments and by private enterprise directed to this end. In my humble opinion any considerable improvements tending to economy are not to be arrived at in that direction; most of the boilers now in use are constructed so as to produce the most violent ebullition, the result of which is, that I have found by the most exact measurement that from 25 to 40 per cent of water is carried over by, and mechanically mixed with, the steam in its passage from the surface of the water in the boiler to the cylinder of the engine. This water, which costs a considerable expenditure of fuel to increase its temperature nearly up to the point of vaporisation, produces no profit, but, on the contrary, robs the steam of its temperature, and consequently diminishes its power.

The real question to solve is, What is the greatest amount of motive power which can be developed from a pound of coal? I have proved that the former question is not the one the solving of which is of any importance, for, by my system, only two-thirds the quantity of water are used, which actually exerts more power.

The great desideratum is to obtain increased power, or economy in fuel, without the commercial disadvantage of occupying more space by the enlargement of boilers and engines, and, in war-steamers, to perform the longest voyages with the complement of coal which they are enabled to stow.

It is conceded that the Cornish boilers are the most economical, the combustion of the fuel being slow; the ebullition is not violent, but their immense size precludes their employment in steamers: I am therefore compelled to direct my attention to what we find in common use throughout the steam world afloat.

In 1858 the total tonnage of the United States was	5,050,000	tons
Of which the steam tonnage was . .	729,390	„
In 1857 the total tonnage of Great Britain was	5,520,000	„
Of which the steam tonnage was . .	671,500	„

Of this 1,400,000 tons propelled by steam-power, I venture confidently to assert, that the expenditure per indicated horse-power per hour amounts to six pounds of coal, and that fully one-third of the immense cost of running these steamers will be saved by a proper application of the system which I have recommended. There is a vast difference between employing a pure vapour, and steam saturated with water.

A volume of water requires, for its conversion into vapour, 5½ times as much heat as is sufficient to heat it from the freezing to the boiling temperature, the greater part of which is absorbed, and is inappreciable by the thermometer, it is therefore called *latent* heat by Dr. Black, in contradistinction to that measured by the thermometer, which is called

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sensible heat. The heat absorbed by one volume of water amounts to 1,000° F.; this would heat 1,000 volumes of water one degree, or raise one volume of boiling water placed in a vessel where the temperature can be maintained to 1,180°. Should this vessel be suddenly opened it would be in one moment emptied by vaporization, inasmuch as the full amount of caloric equivalent to its constitution as steam, is present. (I incline to the opinion that this well-established fact applied, to the explosion of the water-casing around the chimney of the Great Eastern, might clear away some of the mystery attached to it.)

On the other hand, when steam is condensed by contact with cold substances, as much heat is lost as is sufficient to heat 5½ times its weight of water from 32° to 212° F., or boiling point; hence it is evident that the heat of the steam, which is in fact the power, should be maintained to the highest practicable point in the cylinder of the engine.

M. Carnot of Paris, in 1824, was the first to advance the idea that in steam machines, the labour effected, is due simply to the passage of heat through the moving power. The greater the difference of temperature of the steam before it entered the cylinder and after it left it, the more perfect were the effects produced. In this theory the dilation of bodies by the penetration of heat changes the nature of a part of the bodies, and the deficit which results therefrom is in proportion to the resistance to be overcome during the accomplishment of the dilation; the heat disappears, but a disposable labour is produced. This theory is mainly borne out by my own experience, and I have the gratification to know that it accords with that of M. Regnault, President of the Institute of France. M. Regnault filled two vessels of exactly the same capacity, which were connected by a pipe and stopcock; one he filled with steam at a pressure of 20lb., and a pressure of 228° our measure, the other being empty. He then opened the cock, when he found the pressure was reduced to 10lb., but the temperature remained the same. This result he expected, because the steam had done no work, but had merely expanded to twice its volume. He then arranged that the steam on its passage from one vessel to the other should turn a wheel to which a friction pulley was applied; the result of this experiment was, that the heat of the steam disappeared just in proportion to the amount of work done. I think, with all due deference to those who have written and experimented on the subject, that this highly interesting fact should be conclusive.

Acting on this theory, that the more heat lost in the cylinder of an engine, the more power would be exerted, and knowing by experience that a great amount of loss was sustained by the employment of saturated steam, which not only had an injurious element in the water which it contained, but also lost power by contact with every substance of less temperature than that of the steam, in the pipes which conveyed it to the cylinder, in the steam-chest, cylinder-sides, and piston-rod, &c.—this loss must necessarily occur whenever ordinary steam is employed; to obviate this loss I determined on superheating the steam, and found that it showed a small economy when surcharged to a certain degree; but, when superheated to a temperature sufficiently high to develope the full extent of the power, it destroyed the packing, and injured the slides

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and cylinders. Finding, then, from considerable experience, that ordinary steam was too wet, and that superheated steam was too dry, I conceived the idea of mixing a portion of the saturated with the superheated steam, and found that it not only acted as a perfect lubrication to the rubbing parts of the machinery, but produced a power superior to that obtained from the use of either of the other steams separately.

Super-heated steam has been frequently tried, and its use abandoned as of no real commercial value, because, when all the steam from the boiler is super-heated, the temperature must vary exactly in proportion as the heat of furnaces varies; and, in cases where the required quantity of steam is most difficult to raise, the temperature of the super-heated steam must necessarily be the highest, and consequently the most dangerous.

I have no doubt there are officers in the Navy present, who know that at times it is extremely difficult to keep steam up to the desired pressure; and, of course, when that is the case, there must be less steam passing through the pipes from the boiler to the cylinder, and, as it is subjected to the same heat in the uptake, it must necessarily be greatly increased in temperature.

In carrying my system of combined steam into practical effect, I use *two* pipes in connection with the boiler, one of which conveys the ordinary steam to the cylinder, the other is connected with pipes convoluted, or arranged in any convenient form or place in the uptake, or chimney of the boiler (see Diagram), and conveyed thence by a pipe, which is joined to the first pipe at or before its entrance into the cylinder. This portion of steam through these pipes becomes super-heated to some 500° or 600° by the *waste heat* which is arrested after having passed through the boiler-tubes, and utilized in the cylinder. When the two kinds of steam inter-penetrate, the super-heated steam acts, by its excess of heat, on the watery particles of the saturated steam, expanding them some hundredfold by converting them into vapour; whilst, at the same time, the super-heated steam is changed from a dry gas into a highly expansive vapour, *i. e.*, into pure steam, at a temperature so high as to develope the full extent of its power. By this system it is readily seen that the temperature of the steam is entirely under the control of the engineer, for by merely turning a valve he can so regulate the temperature as to produce the maximum power. A thermometer is placed in the mixed steam, as a guide to the engineer.

Some have asserted that super-heated steam will produce as much power as combined steam. I am quite sure that those who make this assertion have never given the two systems a fair trial. The experiments made by order of the three great Governments prove conclusively that the combined steam possesses every advantage over either super-heated or ordinary steam, independent of its superior economy. Those made by order of the United States Government, by the Engineer-in-Chief in person, proved that there was an economy in combined steam of 52·5 per cent. over ordinary steam, and 25 per cent. over super-heated steam. The experiments conducted by order of the Minister of Marine of France gave nearly the same results; the economy being 52·7 per cent. over ordinary, and 24 per cent. over super-heated steam. The experiments conducted by the British Government, extending through a series of

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voyages, show an average economy of 32 per cent. in favour of combined steam over ordinary, when a proper application was made. The means of the power exerted by combined steam was 500 horse-power; super-heated steam, 409 horse-power; and with ordinary steam, 404 horse-power. The Lords of the Admiralty, for the purpose of giving a decisive settlement to this question, have ordered H.M.S. "Rhadamanthus" to be fitted so that either of the three kinds of steam can be used separately,—in a few weeks this highly interesting trial will be made. As an important fact bearing on this question, it was ascertained by a committee appointed by the Maryland Institute to investigate the matter, that a cistern of water was boiled at Wetheredville in one-third less time by the employment of combined steam than with super-heated steam, at the same temperature and boiler pressure.

The *rationale* of the system is, that super-heated steam partakes of the nature of gas, is a bad conductor of heat, and parts with it with difficulty; whilst the combined steam, being a pure vapour, is a good conductor of heat, and readily parts with it, which is transformed into mechanical power. In the experiments, where the heat has been measured, the combined steam always parts with more heat in the cylinders.

The indicator cards before you were taken by the Engineer officers of tho Admiralty, when experimenting on the "Dee." The inner card represents the super-heated steam,—the outer one the mixed steam. You will observe that the vacuum is much better in the latter, and that a great deal more power was exerted. The expansive force is carried out nearly to the end of the stroke. The area of the feed-valves was the same in both cases.

I have promised the Lords of the Admiralty that every steamer in the Royal Navy to which my system shall be properly applied, will be enabled to perform a voyage one-fourth further, at the same rate of speed, with the same rate of fuel; independent of which, the desired pressure can be maintained at all times, and increased at will. I need not point out this great advantage to the present assembly. Many officers know the value of an inch or two more of steam in cases of emergency, such as being on a lee-shore, or in pursuit of an enemy; or, if you can imagine such a case, pursued by an enemy,—a few pounds of steam might save the ship, or gain another.

In conclusion, I will point out some of the advantages resulting from the use of my system:—

1st. One-third of the wear and tear of boilers saved, inasmuch as only two-thirds of the quantity of fuel is required; and, as only two-thirds of the usual quantity of water are required to supply the boiler, two-thirds of the deposit are prevented.

2nd. Increased speed acquired when required.

3rd. Priming prevented.

4th. One-third of the room now occupied by coal can be used for freight; or, a vessel will perform a voyage one-fourth longer with the same quantity of fuel.

5th. A better vacuum always obtained.

6th. The desired pressure readily maintained.

7th. It is entirely safe, and under perfect control.

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8th. Should any accident happen to the super-heating apparatus, by merely closing the supply valve to it at the boiler, the machinery is worked by the ordinary steam as heretofore.

THE CHAIRMAN: What is the arrangement that enabled them to obtain the Diagram before us?

Mr. WETHERED: It is very similar to the plan exhibited (see Plate, figs. 1 and 2), except that they had some of the pipes running up the chimney.

THE CHAIRMAN: That is only heated by the up-take.

Mr. WETHERED: The other was too.

THE CHAIRMAN: That would be a sufficient reason why the Diagram should be smaller. The fact of its being in the up-take is a reason why the Diagram should be of less power.

Mr. WETHERED: We find sufficient temperature in all steamers in the up-take. In the "Dee" it is between 500° and 600°; we know in some cases the heat to be as high as 750°. It is so with some of the finest steamers that run from Southampton. I may remark, that the superheating application to the "Dee" was different from the plan exhibited, some of the pipes being placed vertically up the chimney; but the Admiralty thought that would be entirely out of the question for war steamers, as they would be in danger from the shot of the enemy. Therefore I was obliged to adopt a plan of putting in two tiers of pipes entirely below the top of the boiler. There are two pipes attached to the boiler; one the ordinary pipe which carries the steam from the boiler to the cylinder, and the other arranged so as to supply the super-heating pipes.

It may be readily seen that, by the system of mixing steam, it is easy for the engineer to ascertain what temperature will produce the maximum power with safety. By merely turning the valve he has it perfectly under command, and can produce the maximum power at will. A thermometer is so placed that he can see at one moment at what temperature he is working his engine. If he finds it too high, he can turn on a little of the saturated steam, and reduce its temperature. This cannot be done when super-heated steam alone is used, because the temperature is determined by the heat of the furnace and fluctuates with it necessarily.

THE CHAIRMAN: You would still retain the general arrangement of keeping your convolute pipes in the up-take?

Mr. WETHERED: I would. There is sufficient *waste heat* in the up-take to super-heat a portion of the steam to the desired temperature for mixing. One great advantage attending this system is, that, if anything should happen to the super-heating apparatus on the voyage, all you have to do is to close the valve which supplies the steam for super-heating, and proceed with the same steam as you had before.

Mr. D. K. CLARKE: You mentioned something about the extreme heat damaging the stuffing. What temperature was that?

Mr. WETHERED: About 350° or 400°. At that temperature it will injure the packing. I have known some of the steamers that used the super-heated steam, which not only destroyed the packing, but damaged the surface of the cylinders.

Mr. D. K. CLARKE: At what temperature is your combined steam?

Mr. WETHERED: About 350°.

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Mr. D. K. CLARKE: That is nearly the same.

Mr. WETHERED: Yes, but mine is lubricating steam.

Mr. D. K. CLARKE: Then you do not think it would be so hurtful?

Mr. WETHERED: Oh, no. I can work combined steam at a higher temperature than super-heated steam, which is entirely dry. The "Dee" has had the combined steam in operation for two or three years, and has not had the slightest difficulty, the temperature being sometimes 350°. The "Black Eagle" Admiralty yacht has had it a long time, and she makes a considerable economy of fuel and increase of power. It has been applied to the Royal Mail steamer "Avon," and she has run about 160,000 miles, and has not had the slightest difficulty with it, except on one occasion in the tropics, when the engineer heard a slight screaming at the slides. He immediately turned on a little more saturated steam, and he has had no further difficulty. Since I came to England I find that several parties have been trying to pirate from me, by employing simply super-heated steam. The Royal Mail Company, after having tried their several different plans, have placed one of the finest of their steamers at my disposal for a proper application of my system, and stated in their last report, that, if successful, it would be applied to all the steamers on their line.

THE CHAIRMAN: In drawing a distinction between common steam and super-heated steam, you said one was a mere vapour, and the other a gas. Do you mean to say a chemical action takes place; that one is merely a mechanical separation of the particles of water, and the other a chemical separation?

Mr. WETHERED: I think so; you could not call it a hydrogen gas, but it approximates to it.

THE CHAIRMAN: Is there any electricity given off?

Mr. WETHERED: I have thought there was electricity evolved when the two kinds of steam came in contact. On one occasion I heard a noise, as if ten thousand little tacks were dancing along the inside of the pipe, and I judged it to be caused by electricity.

Mr. D. K. CLARK: I think it is of some importance to know whether there is any essential difference between combined steam and super-heated steam at the same temperature. As the pressure and density are practically the same whether you use super-heated or combined steam, taking the same temperature, I am at a loss to know what the essential difference is.

Mr. WETHERED: There have been theories started for the purpose of explaining the superiority of mixed steam over super-heated steam, even at the same temperature. Professor Regnault, who has had as much experience in steam as any of us, says, as a general remark, that he could not see why super-heated steam at the same temperature would not perform as much work as combined steam. The Abbé Moigno, Editor of the Cosmos, said, it is not the fact, as he had watched it for whole days, and had observed that, as soon as ever the steam was mixed, the engine has exerted a power of 24 per cent. more than when steam simply super-heated was employed.

Mr. D. K. CLARKE: You mean, as they mix super-heated steam with common steam.

Mr. WETHERED: Yes.

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Mr. D. K. CLARKE: No doubt the engine runs off because the steam is drier.

Mr. WETHERED: No; when they are using super-heated steam, and they mix it, the engine will increase its revolutions. The steam then is not so dry, but elastic. It might be that super-heated steam is like so much hot air when it is cooked too much, there is not the moisture and elasticity in it that a pure vapour contains. The reason I have given is the same as that given by Professor Regnault, that the one partakes of the nature of gas, is a bad conductor of heat, and does not part with it readily; whilst the other, being pure vapour, is a good conductor of heat and parts with it readily, and consequently exerts more power.

Mr. D. K. CLARKE: I do not know that Regnault has made experiments on super-heated steam. He has made experiments on saturated steam.

Mr. WETHERED: The learned Abbé Moigno, the associate of the illustrious Arago in his interesting scientific discoveries, witnessed the experiments made by the French Government with super-heated and combined steam, and submitted the detailed results to M. Regnault, who, upon investigation, gave the *rationale* which I have just communicated, and with which I entirely concur, as I have always found it the case that more heat is utilized when the mixed steam is used than when either super-heated or ordinary steam is used; and there is strong confirmatory evidence in support of the theory in the report of the committee of the Maryland Institute on boiling water with the three kinds of steam.

The HON. CAPTAIN DENMAN: May I ask to what temperature you heat super-heated steam when it leaves the boiler, in order to get 350° at the cylinder?

Mr. WETHERED: From 500° to 600°. It varies between these figures according to the draught of the boilers.

The HON. CAPTAIN DENMAN: May I ask also the size of the super-heated steam-pipe and the ordinary pipe?

Mr. WETHERED: The ordinary pipe of the "Rhadamanthus" is about ten inches; the super-heated steam-pipe is only five inches. With the super-heated steam I always leave the valve wide open, because it is subjected to greater friction than it would be with the ordinary steam.

The HON. CAPTAIN DENMAN: You keep the temperature at 350°?

Mr. WETHERED: We can use it considerably above that point with safety. But with super-heated steam at that temperature the slides have been damaged.

The HON. CAPTAIN DENMAN: Has it been found that super-heated steam unmixed, at 350° damages the slides?

Mr. WETHERED: Yes, and the surface of the cylinder also. A number have been damaged. A short time ago some experiments were made on the steamers that run from Panama down the west coast of South America. The consumption was reduced very low, and it was startling to see the enormous economy stated to have been made. They super-heated the steam as part of their plan, and used surface condensers, and a number of good things. Not more than three weeks ago I received a letter stating that the super-heated steam apparatus had all been taken out, as it damaged the slides and cylinders.

The HON. CAPTAIN DENMAN: You think it is a great advantage to lower the temperature by mixing?

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ARRANGEMENT OF PIPES FOR APPLYING WETHERED'S SYSTEM OF COMBINED STEAM.

Fig. 1.

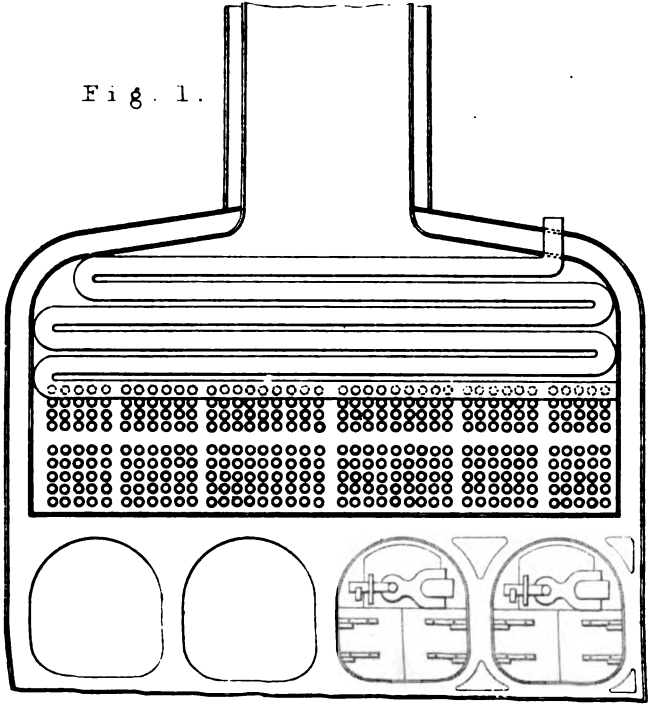
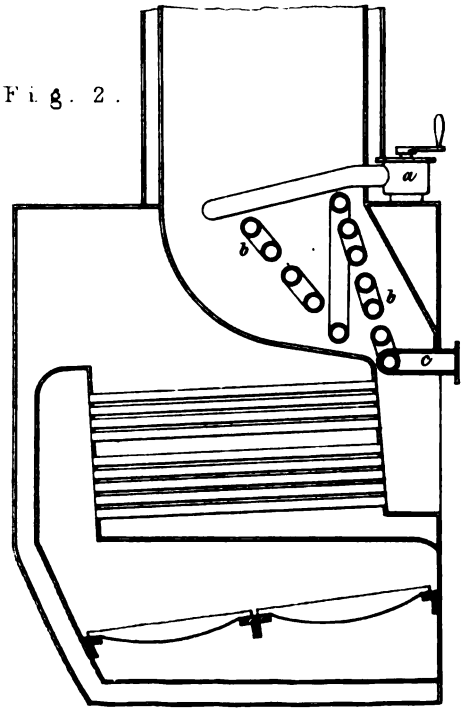


Fig. 2.



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Mr. WETHERED: It is a great advantage, independent of the complete control which it gives the engineer over it.

The HON. CAPTAIN DENMAN: You know of no other means of doing it?

Mr. WETHERED: I do not know of any. I may add, that the question to which the gentlemen referred, with regard to the value of the two kinds of steam, will soon be decided by the Lords of the Admiralty. They are fitting the "Rhadamanthus" up for the very purpose of setting that matter at rest. I am perfectly willing to leave it in their hands. And I avail myself of this occasion to tender my acknowledgments for the uniform kindness and courtesy which I have received by all in connection with the Admiralty and Navy with whom I have been brought into contact.

THE CHAIRMAN: Mr. Wethered has been kind enough to introduce to us a very important and interesting subject. He has put it in a very simple and intelligible way. Of course, one cannot, without being present at the experiment, venture to pronounce entirely in favour of it; but, certainly, so far as the system has been explained, it possesses a decided advantage. I can quite understand the economy; it is quite palpable to anybody who understands it. It is clear that if a convolute is placed in the up-take to retain the heat, which is often found going to waste through the top of the funnel, it would be a great economy. We are all very thankful to Mr. Wethered. His report is the more interesting, in that he is an ex-senator of the United States, and has come to lecture in the Royal United Service Institution of Great Britain. I trust it is an omen that the two countries will continue joined together in a rivalry for the advancement of the arts and sciences.

DESCRIPTION OF THE PLATE.

Figs. 1 and 2 are longitudinal and transverse sections of an ordinary tubular boiler, showing the pipes for super-heating the steam in the uptake.

a. Stop-valve, by which steam is admitted from the boiler to the pipes *bb*, by which it is super-heated, and from thence it is carried away to the cylinder by the pipe *c*, *where it is mixed with the ordinary steam.*

This arrangement of super-heating pipes can be readily applied to existing boilers. A stop-valve is fitted on the boiler, for admitting the steam into these pipes, which is heated to a temperature of 500° or 600°, and then carried to the cylinder, where it is mixed with the ordinary steam direct from the boiler, by which process a saving of fuel is effected of from 25 to 33 per cent., as well as a considerable increase of power given, as shown by the reports of the Admiralty of the application to H. M. Ship "Dee."

The Royal Mail Steam Packet Company's Ship "Avon" has made voyages to the Brazils and back, amounting to 160,000 miles, with this system of combined steam, with the most perfect success.

It is thus shown that vessels capable of carrying by the present system only 32 days' consumption of coal, can, by adopting Wethered's system of combined steam, maintain the same speed with the same quantity for 40 days, a desideratum so highly important that it needs no comment here.

The foregoing explanation applies to marine boilers, but this system of combined steam is equally applicable to all steam power.

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Evening Meeting.

March 19th, 1860.

Captain E. G. FISHBOURNE, R.N., C.B. in the Chair.

NAMES of MEMBERS who have joined the INSTITUTION since Feb. 20th.

LIFE.

Hand, Geo. Wightman, Mid. R.N.
Tytler, W. F., Capt. 9th Beng. Lt. Cav.

ANNUAL.

Barnes, C. H., Lieut. H.M. Beng. H. A.
Wickham, E. H., Lieut. R.A.
De Salis, Rodolph, Col. 8th Huss.
Reilly, W. E. M., Major R.A. C.B.
Philips, N. G., Capt. Hon. Corps Gent.-at-Arms
Carter, J. M., Capt. Monmouth Mil.
Croft, C. P., Surg. Victoria Rifles
Greathed, E. H., Col. unatt. C.B.
Birch, Thomas F., Capt. R.N.
Luard, John, Maj.-Gen. Mad. Army
Colomb, P. H., Lieut. R.N.
Stephenson, H. J., Capt. late 18th Royal Irish, 1st Surrey Rifle Volunteers
Dent, Edward, Com. R.N.
Sturdy, J. B. S., Capt. 5th Lancashire Volunteers
Cooper, R. A., Capt. Sco. Fus. Gds.

PRESENTS.

LIBRARY.

Books.

Philosophical and Literary Society of Leeds.—Sensorial Vision: a Paper read by Sir J. F. W. Herschel, Bart., K.H., F.R.S., before the Society, 30th September, 1858. Pam. 8vo. Leeds, 1858.

China and its Trade: a Paper read by J. Crawfurd, Esq. F.R.S., before the Society, 17th November, 1858. Pam. 8vo. London, 1858. *Presented by the Society.*

Yonge, W. L., Captain, Dep. Asst. Adj. General, R.A.—Notes on the Early History of the Royal Artillery. Part I. Pam. 8vo. Woolwich, 1859. *Presented by the Author.*

Marcy, Colonel Commanding 1st Regiment of Cuirassiers.—Memoir on Swords, &c. Translated from the French by Captain and Lieut.-Colonel Henry Hamilton Maxwell, H.M. Bengal Artillery. Small 8vo. London, 1860. *Presented by Mr. John Weale.*

Zoological Society of London.—Proceedings of the Society. Part III., June. Dec. 1859. *Presented by the Society.*

Rules and Regulations for Her Majesty's Colonial Service. 1 vol. 8vo. London, 1856. *Presented by W. F. Higgins, Esq.*

Lecture on the Geology of the Province of Nelson. Extract from the New Zealand Government Gazette of the 6th December, 1859.
Presented by W. Gisborne, Esq., Under Colonial Secretary, New Zealand.

Hewitt, John, Esq., Mem. Archæ. Inst. Gt. Britain.—Official Catalogue of the Tower Armouries. 1 vol. Small 8vo. London, 1859.
Presented by the Secretary of State for War.

Royal Geographical Society.—Proceedings of. Vol. IV. No. 1. 1860.
Presented by the Society.

Adye, John, Lt.-Col. R.A., C.B.—Review of the Crimean War to the Winter of 1854-5. 1 vol. 8vo. *Presented by the Author.*

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Nares, George S., Lieut. R.N.—The Naval Cadet's Guide. 1 vol. 8vo. London, 1860. *Presented by the Author.*

Lyon's Voyage to Repulse Bay. 1 vol. 8vo. London, 1825 *Presented by John Barrow, Esq., F.R.S.*

Maps, Charts, &c.

Map of North Holland, given to Prince William, at the Helder, on 29th Oct. 1799, by Col. Kragenheim, Chef d'Etat Major to the Dutch Army during the War in Holland in 1799. *Presented by W. F. Higgins, Esq.*

MUSEUM.

Military.

Bow. 2 Iron-headed Spears. 3 Wooden Javelins from the Island of Palawan. *Presented by Captain E. Gardiner Fishbourne, R.N., C.B.*

Musket recovered in 1859 from the wreck of La Latine, frigate 32 guns, Captain Launcelot Skymer, which frigate sailed from Yarmouth Roads for Hamburgh on the morning of 9th October, 1799. She was lost in a heavy gale the same night on the outer bank of the Island of Vlieland, and, with the exception of one man, every soul perished. *Presented by Captain George Halsted, R.N., in name of the Committee for managing the affairs of Lloyd's.*

Battle Axe brought down from the Great Lake, discovered by Dr. Livingstone. *Presented by Mr. W. G. Rawbone.*

Miscellaneous.

Russian Water Bottle or Canteen from Sevastopol. *Presented by Mr. E. Kiddle, War Office.*

Specimens illustrating the Manufacture of Gun Flints. *Presented by the Royal Institution of Great Britain.*

Part of a Flag of H.M. Ship Victory, carried in procession at Lord Nelson's funeral, which it was intended should have been lowered into his vault, but was torn up and appropriated by the sailors who carried it. *Presented by Captain W. H. Dobbie, R.N.*

1 Medal, Danube (silver). *Presented by the Lords Commissioners of the Admiralty.*

NEW SYSTEM OF COOKING FOR THE ARMY.

By Captain J. Grant, *late* R.A.

I have been requested to offer you some explanation of this new system of cooking for troops which I have lately introduced into the Service, and, although it is a homely subject for a Lecture, it is one which is deserving of more attention than it has hitherto received.

We know what all the armies suffered from bad food during the Crimean war; and, although the British soldier is better supplied than any other soldier in Europe, he is by no means the best fed—simply from defective cooking.

This induced me to turn my attention to the subject with the view of providing a remedy for this great defect in our system, and placing within the soldier's reach some simple mode of cooking his food agreeable to his taste, instead of being confined to his every day "soup and *boulli*." We do not want Soyer cooks for teaching our soldiers, for, although the majority of them are bad cooks, there are good ones enough to teach the rest, under intelligent non-commissioned officers,—and the sooner

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this is reduced to a system the better, for a School of Cookery is quite as essential as a School of Musketry. It is no use having rifled guns and muskets without good men to work them; and we cannot have good men without good food.

The models on the table represent the three different modes of cooking which I propose for the soldier's use, in barracks, in the field, and on the march. This model, which is on the ⅛ scale, represents the mode of cooking in barracks, which enables the soldier to *bake*, *boil*, *steam*, or *fry* his food, in any way agreeable to his taste.

In this apparatus (see Plate I. fig. 3) you will observe there are two small fires on a level with the floor line,—the ash-pits being taken out of the ground, which gives the men a good command over the cooking vessels —these two fires are connected by a brick flue, covered with iron plates to receive the cooking vessels; both flues terminate in one chimney, in which an oven is placed, heated by the products of the two fires in its passage up the chimney, and is capable of baking 400 rations of meat.* Each of the twelve kettles will steam or boil meat and soup for 50 men, and the vegetables are steamed over the kettles: thus the rations of 1000 men may be cooked in this apparatus, although it is constructed for only 500. The hot plate also affords the means of frying or stewing any small messes that may be required; and I consider a hot plate for a soldier's permanent kitchen a great acquisition.

It is supposed by some persons that this mode of cooking in barracks is only applicable to a large number of men—but this is erroneous; for, although none of the apparatus which has hitherto been constructed has been for less than 500 men, the principle is as applicable to a hundred as it is to a thousand. You will observe that the construction of this oven is somewhat different from the generality of iron ovens, which give a peculiarly strong taste to the meat; but by this mode of heating such a high temperature can be raised, that I can afford to have a current of air constantly passing through it, by means of these ventilators, so that the meat becomes more like roast than baked.

At Aldershott all the cook-houses are fitted, by order of the Government, for the requirements of 1000 men, with kettles containing 20 gallons; but I ventured to recommend that apparatus for 500, at a cost of about 80*l.*, with 12-gallon kettles, would be more convenient. This was approved of, and all that have since been constructed upon this principle have been for this number, and I have heard of no complaints. I ought to add that the work at Aldershott was badly carried out, and that this principle of cooking must not be judged of by the manner in which it is conducted in that encampment; although some allowance must be made, as this was the station where it was first introduced in April, 1855.

*The 400 rations of meat are baked with the *waste* heat which is generally thrown off by the chimneys, and there is no difficulty in applying this principle of baking to all our ships of war. A portion only of that heat which is now wasted in all the smoke flues and cooking galleys throughout the navy, would, if properly applied, suffice to bake bread enough for the whole fleet; and an occasional change of soft bread for the every day biscuit would be appreciated by our sailors, and much valuable stowage space gained in the bread rooms, besides effecting a large pecuniary saving to the country by the purchase of flour for our ship's crews when on foreign stations.—J.G.

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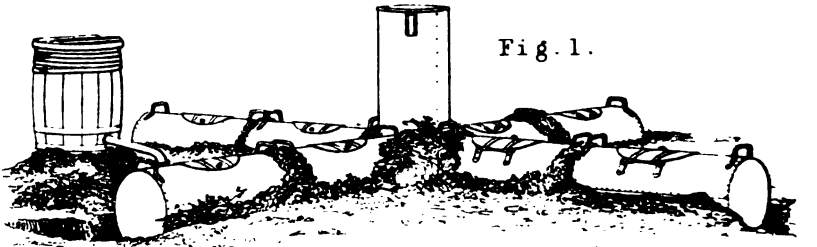
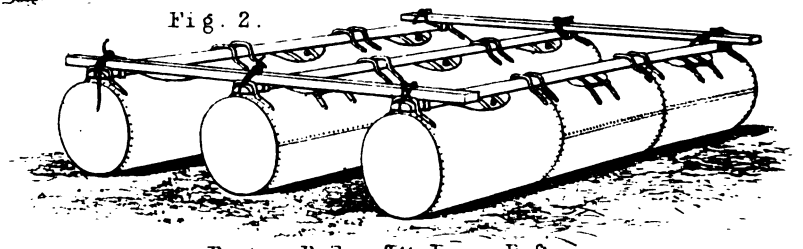
CAPTN GRANTS COOKING APPARATUS

Fig. 1.



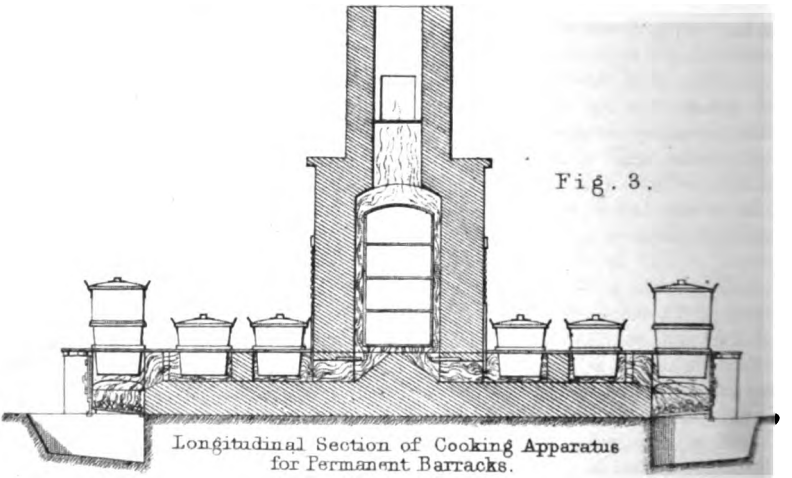
Pontoon Boilers in use in the Trenches.

Fig. 2.



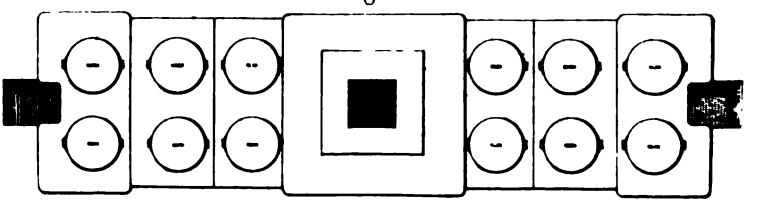
Pontoon Boilers fitted as a Raft.

Fig. 3.



Longitudinal Section of Cooking Apparatus for Permanent Barracks.

Fig. 4.



Plan

0 1 2 3 4 5 10 FEET

J.R.Jobbins

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I will now explain the mode of cooking in the field:—

I call these cooking vessels, which are made of plate iron galvanized, "Pontoon Kettles," (see Plate I. fig. 1), because from their peculiar form they answer the purpose of pontoons as well as cooking kettles: they are packed for travelling in one of the ordinary artillery waggons (Plate II. fig. 2), fitted for the purpose, and furnished with all necessary fitments, such as spades, pickaxes, cross-cut saws, hand-saws, axes, &c., for cutting trenches, and felling trees for fuel. The waggons are drawn by a pair of horses when the vessels are empty, and by four horses when filled with provisions. When the troops arrive on their encamping ground, they select as level a spot as they can, and commence cutting the trenches in the shape of a cross, and at the intersection a small chimney, three feet high, is placed, resting on the ends of the kettles which occupy the trenches, two kettles being placed on each arm of the cross (see Plate I. fig. 1). Fires are then lighted at each end of the four trenches, and in about two hours-and-a-half the dinners for 800 men can be well cooked. During the two last summers, two batteries of artillery cooked in this way at Woolwich.

The dishes are provided for cutting up the messes, which also answer the purpose of frying-pans; and when the soup and meat is ready to serve, the frying-pans are put in requisition. Means are also provided for steaming either meat or vegetables, for wherever there is artillery there must be empty powder barrels, in which the steaming is carried on, by the aid of a short piece of gas-pipe, to conduct the steam from the cooking kettles into the barrels. These kettles may be worked from a single kettle up to the full number of eight, either in one line of trench or in the form of a cross; and a turf chimney will answer as well as an iron one; and the cooking may be carried on in any kind of weather. Another advantage is the facility of transport; for the kettles can be easily slung on the backs of horses or mules, and from their cylindrical form will bear the rough usage to which they are necessarily exposed. Each kettle is three feet long and fifteen inches in diameter, containing twenty-five gallons, and weighing sixty-two pounds. There is also a provision for roasting a sufficient quantity of coffee for a thousand men over the chimney, and grinding it at a gun-wheel during the time occupied in cooking the dinners, and the coffee roaster packs inside the chimney when travelling.

I will now shew the mode of forming a raft by the aid of these kettles, (Plate I. fig. 2), and with two sets of them I would undertake to transport a battery of 12-pounders across the Thames. I do not know whether any person present witnessed the trial of these kettles in Hyde Park, during the last summer, but His Royal Highness the Duke of Cambridge attended with much interest, and said: "I understand all about your cooking, but I want to see how you manage to get troops across a river." So after the dinners were all served the kettles were removed from the trenches (which were cut near the Serpentine), and in about five minutes two rafts were formed. Four guardsmen manned one, and four artillerymen the other, and they crossed and re-crossed the Serpentine with perfect ease and safety, to the amusement of all who witnessed the trial. A river may easily be bridged

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by the aid of these kettles for a regiment to cross in double file, and the cooking kettles of half-a-dozen regiments will suffice to bridge a good sized river.

I will now explain the mode of cooking while troops are on the march—

With this single cooking vessel, which I call an "ambulating boiler," (see Plate II. fig. 1), dinners may be well cooked for 800 men in 2½ hours, the horses walking or trotting. This is also made of galvanized plate iron, but rather thicker than the pontoon kettles. It is somewhat peculiar in construction in order to obtain a large amount of heating surface. It is fitted on one of the ordinary artillery waggons, and furnished with all the same kind of fittings and tools supplied to the pontoon waggon. The boiler contains 180 gallons and is graduated on the outside, so that, whatever may be the number of men to be cooked for, the cook has only to refer to the figures which are marked outside the boiler, and the number of gallons of water required is at once ascertained. The meat and potatoes are boiled in nets, and that which is intended for soup is cut small and put into the boiler first. The motion of the waggon while travelling keeps this in constant agitation and prevents the necessity of stirring. When it is ready to serve out, the nets which contain the meat and potatoes are hooked out of the boiler at a door at the top, and the soup is drawn off by means of two large taps into two soup kettles provided for this purpose, and from which the men receive it. I have seen the dinners of 500 men served from a boiler of this description in a quarter of an hour. There is also a great saving in the consumption of fuel, for it requires only *one-eighth* part of the present Government allowance, which is 3 pounds of wood per man a day for field service. This admits of two days' fuel for 800 men being carried in the same waggon, which answers the double purpose of cloathing the boiler and assisting to dry the wood if green or wet. The waggon may be drawn by a pair of horses when the boiler is empty, for it weighs only 6½ cwt., but when filled four horses are necessary. I have seen one of these boilers trotted down Shooter's Hill, full of soup, and on its arrival at Dartford Heath dinners for 600 men were served out.

In introducing these modes of cooking for the army, I wish it to be understood that I do not propose to deprive the soldier of the means of cooking his own rations, under any circumstances, on the contrary, I think it so important that he should be independent of all aid that I have designed a little mess tin, which will enable him to cook his ration with a pound of vegetables in half-an-hour with proper management; but I consider it equally important to furnish the means of transport for cooking vessels when troops are acting in large bodies, and it is only those who know the practical difficulties of soldiers carrying our lumbering camp kettles on a march, who can understand the importance of providing transport for cooking vessels. This is, however, becoming better understood, for I have been requested to direct the construction of sufficient field cooking apparatus for 5,000 men destined for service in China. This I have seen completed and shipped.

The cooking apparatus for barracks was first introduced in the Hut Barracks at Aldershott, in April, 1855, in consequence of the then mode of cooking with iron stoves being found so inefficient that it became necessary

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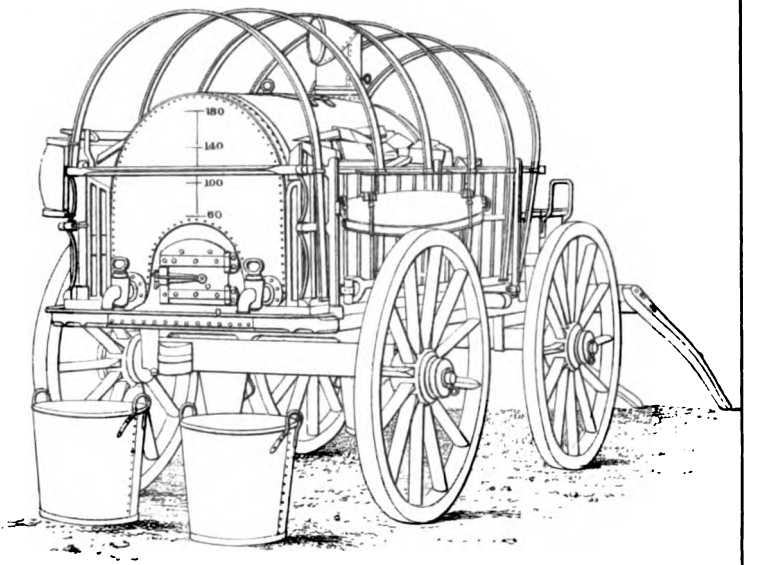
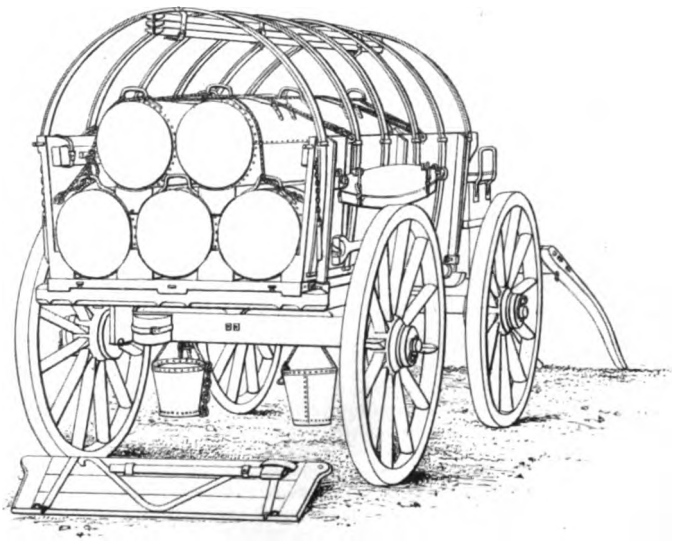
CAPTN GRANTS COOKING APPARATUS.

Fig. 1.



End View of Ambulatory Boiler Wagon.

Fig. 2.



End View of Pontoon Boiler Wagon.

J.R.Johbins.

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to remove them. Since that period the whole of that encampment has continued to cook upon this new plan, although the construction of the work was badly carried out under our contract system, for the brickwork was very defective.

This mode of cooking has since been extended to the Curragh and Shorncliffe camps, and some garrison towns, and, although much better carried out than at Aldershott, there is still room for improvement in the brickwork, which requires to be of the very best description.*

I must here repeat that cooking for an army is a matter of much greater importance than has hitherto been attached to it.

When I first turned my attention to the improvement of our system, the different modes of cooking throughout the service (from iron coal stoves to gas) were as varied as the cost, which ranged from *five farthings* to *five pence* per man per week for fuel to cook three meals daily. For example: at St. George's Barracks in London, where the soldiers had been cooking with gas for some years, the barrack master's fuel return for December, 1858, will shew that it amounted to *five pence* per man per week for cooking purposes alone, whereas upon this system of cooking it only amounts to *one halfpenny* per man per week, and I am prepared to prove that the principle admits of its being reduced to less than *one farthing*.

These results were obtained after much labour and expense, and if the authorities whose duty it may be to provide proper cooking accommodation for our troops had expressed any desire to confer with me upon the subject, a good and uniform system of cooking, which is much wanted, might have been established throughout the Service long since.

I regret to add, that during the prosecution of this work I have experienced something more than the ordinary difficulties which always attend the introduction of everything that is new, for I have had to contend with much opposition; but the admission of improvements for the benefit of the public service should not be made dependent upon their emanating from an official source.

In conclusion, I beg to state that I have devoted many years to the consideration of cooking and baking bread for our army:—for, strange to say, the English army is the only one in Europe which does not bake its own bread, and I can now state with perfect confidence, that if this system was properly carried out, and the soldiers instructed as they ought to be in cooking and baking, that better food of every kind would be secured to the soldier, and a very large pecuniary saving secured to the country.

The CHAIRMAN: I am sure that this Meeting feels much indebted to

* This mode of cooking and baking bread has been in operation at the London Reformatory, 237, Euston Road, for the last three years; but the principle has been better carried out at the New Schoolhouse at Southall, than at any military station I have seen. Provision is there made for the cooking and baking bread for 500 children, besides supplying hot water for baths and washing the linen of the whole establishment. This schoolhouse has lately been erected, at a cost of £16,000, for the education of the pauper children of the Marylebone Union, and is situated close to the Southall Railway Station on the Great Western line, about ten miles from London. The establishment is well worth visiting.—J. G.

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Captain Grant for the interesting and valuable information which he has given us upon this important subject. Captain Grant has not only introduced a good system of barrack cooking in every variety, but he has designed an equally efficient mode of cooking for an army on the march and in the field.

NOTE.—On referring to the Official Report, printed by order of the House of Commons, and laid before Parliament the 8th of June, 1858, headed "Captain Grant's Kitchens," it is stated that Captain Grant's system of cooking is not only very superior to the old boiler system, but it effects a saving in the garrison of Woolwich of $297\frac{1}{2}\frac{7}{0}$ tons of coal per annum upon every thousand men.—J. G.

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LOYSEL'S PROCESS FOR MAKING TEA AND COFFEE IN LARGE QUANTITIES FOR TROOPS.

By MR. E. LOYSEL, Assoc. Inst. C.E.

THE introduction of these machines into the British army was suggested to me by Captain Fowke in the year 1855, when Secretary of the British Commission at the Paris Exhibition, where these machines were exhibited, and were at work for five months. All the coffee and tea that was consumed during the Exhibition was manufactured by them. They attracted the attention of his Majesty the Emperor, and, in consequence, I had the honour of offering him the first cup that was made (in a large machine on this principle by steam power) at the Paris Exhibition. It was naturally brought under the notice of the French Secretary at War, Marshal Vaillant, and a commission was named to examine the invention. Their report was satisfactory, experiments were made in the army, and were highly successful, and a large machine was erected in 1855, and is still at work at the *Val de Grace*, the largest military hospital in France, where all sorts of infusions are produced daily. Captain Fowke, having seen the machine at Paris, naturally thought that it might be usefully adapted to the wants of the British Army, and he had the kindness to give me an introduction to Captain Siborne, the Commander of the Royal Engineer Train at Aldershott. Captain Siborne received me with great kindness and courtesy, and gave me all the information I wanted respecting the habits of the British Army. I accordingly had machines for eighty men made at Birmingham, and they have given satisfaction. Captain Siborne, who examined the working of the machine with great care, pointed out various modifications, which I have adopted, to increase the efficiency of the machine, and the machine which I am going to explain to you is constructed from the suggestion of Captain Siborne. It has been in use six months at Aldershott and Chatham, coffee and tea being prepared alternately morning and evening in the same machine. The men report that the machine imparts no unpleasant taste whatever; it has merely to be thoroughly well rinsed after each operation. This fact illustrates practically how easy to cleanse the machine is; and, after six months' use in camp, and in the field, the machine in question is as sound and clean as the first day. Now, if you will allow me, I will read the following Report, which will state better than I can what the apparatus will accomplish.

Copy of a Report by Captain H. S. Siborne, R. E. upon Loysel's Patent Hydrostatic Tea and Coffee Machine, used by the Royal Engineer Train.

SIR, Aldershott, 18 Nov. 1856.

I have the honour to submit for the information of the Lieutenant-General commanding the division, the following report on the "Hydrostatic Tea and Coffee Ma-

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chine," which I recently took to him for his personal inspection. The machine he saw contained 12 gallons; and, as there appears to be an objection to its size, I have since ascertained from the patentee, Mr. E. Loysel, C.E., the price of a 6-gallon machine, and I presume the prices of others of different sizes would be in proportion.

The 12-gallon machine, which can supply tea or coffee for 100 men, costs 10*l.*, whether for a single one or a number of them; that of 6 gallons, suitable to 50 men, would cost 5*l.* 10*s.*

They can be used, however, for only two or three men if necessary, and are consequently extremely well suited to hospitals. I have sent one of them to the Purveyor of the Hospital at this Station, who speaks very highly of it, and is endeavouring to get them generally introduced into the service of the hospitals.

The great merits of the invention are—

1st. The simplicity and celerity with which the tea or coffee can be made for a large number of men.

2nd. The certainty of the essence of the material being entirely extracted from it for the use of the consumer.

3rd. The saving in expense of material which is effected.

The A troop, R.E. train, has now used them for upwards of three months, and we find that the men's meals can be instantaneously provided at any moment. The tea or coffee is as pure as can possibly be produced from the leaves or berries, both being previously ground. Sugar being added before applying the water, its essence is so much better extracted than in the ordinary manner as to necessitate a much smaller quantity of it.

The saving effected to the men's messing amounted (previously to groceries being issued by the Commissariat) to no less than 18 per cent. the only requisites are that both the tea and coffee should be ground, and a quantity of boiling water added equal to the amount of liquor required.

The proportions were an ounce of either tea or coffee to every six men, and a pound of sugar to every eight. These proportions were used in making tea or coffee for an average of 80 men; for very small numbers, perhaps, more material would be requisite.

We used the machines on the occasion of throwing up field-works before Her Majesty in August last with perfect facility, merely boiling the water in the camp kettles; if these had not been at hand the men's canteens might have answered the same purpose.

I drank some of the tea, and found it excellent. From the experience we have had, I am convinced that their introduction into the service would be of the greatest benefit to the soldier, as he would, under all circumstances, when able to secure a supply of hot water, be instantaneously provided with good wholesome liquor, in fact the reverse of what he now sometimes receives, particularly on service. He would save money by means of them when he finds his own groceries, and the public when it supplies them to him.

The one I submitted to the Lieutenant-General was fitted so as to be perfectly portable on service either in a waggon or on a packhorse. For the experience we have had of them, I think their introduction into the service would be of the greatest possible benefit both to the soldier and to the public; and I also beg to bring to your notice the extreme willingness of the patentee to meet any suggestions for improvement, or to make such reduction in the price as not to deprive him of a due remuneration.

(Signed) H. S. SIBORNE,
Capt. Com. R.E. Train.

I will now explain the operation.

The material to be operated on is placed between two or more finely-pierced plates or diaphragms, the lower one being a little distance from the bottom of the containing vessel, and through which a small pipe passes so as to deliver the fluid (poured in a reservoir at the upper orifice) below it. The infusing liquid is then introduced from the upper reservoir, and, displacing the air, forces its way upwards by the pressure of the column (or hydrostatic pressure) through the substance under operation, (every particle of which is saturated in its passage,) and accumulates above the upper plate. When a sufficient quantity has been thus forced upwards, by opening a tap the whole is drawn off, percolating

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again downwards by its own specific gravity through the material, which now acts as a filtering bed, and the infusion is obtained prefectly clear, and containing all the aromatic and useful principles of the substance.

In tea-making, the whole of the soluble and aromatic principles are rapidly and completely extracted, and thus one homogeneous infusion of excellent quality is at once obtained instead of the two or three continually diluted ones which attend the ordinary routine. I am able also, by this apparatus, greatly to increase this effect by previously triturating, crushing, or grinding the tea, and thus exposing a very largely extended surface to the action of the boiling water—an operation which is incompatible with the ordinary tea-pot.

In constructing these apparatus, the dimensions must vary according to the quantity to be treated in them. If I construct a large apparatus, and put in a large quantity of coffee, it will be impossible to expel all the air in the mass of substance by hydrostatic pressure, and percolation cannot take place. To overcome this obstruction, I divide the substance into layers, by using a greater number of perforated diaphragms or filters, and putting one-half or one-third, or a smaller quantity, of ground substance between them as circumstances may require. But here an obstruction occurs, owing to the volume of air there is between the separate layers of substance, and this is got rid of by putting in a vertical tube, perforated so that the air passes off. In Paris I have constructed machines in which they put some 60lb of coffee, and in a quarter of an hour the process of infusion and extraction is completed. These machines have as many as eight chambers; and, by multiplying the chambers and providing for the exit of the air, there is no limit to the size of the machine. It can be applied on any scale for any vegetable substance, in fact it can be applied to brewing, for extracts of dye-wood, and for all sorts of medical extracts. The apparatus may be made of various materials, and in various shapes, to suit the pocket and the taste of the buyer; and, to provide against the infusion getting cold, the machine can be supplied with an enamelled chamber, into which the liquid passes, and there it can be kept hot by the use of a little lamp, or of gas, lighted underneath.

Mr. Loysel next explained the properties of tea and coffee, and discussed their relative merits; and as the result gave the preference to coffee as a beverage to soldiers, both on the ground of economy and health. The soldier in the field, he said, would support fatigue a great deal better, and the quantity of food he would require would be a great deal less. It was found by a practical experiment that the saving would be no less than 25 or 30 per cent.

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The CHAIRMAN.—What is the proportion of coffee you ordinarily give?

MR. LOYSEL.—Scientific authorities in France recommend an ounce and a half to a pint, but that makes a very strong coffee. In this country I recommend one ounce to the pint.

The CHAIRMAN.—You recommend that the tea should be triturated or bruised. Why do you bruise the tea?

MR. LOYSEL.—Because I extract more of the properties of the tea, and the infusion is instantaneous. It is an error to think that by triturating the tea it will extract too much, and give a woody taste. In tea there is nothing obnoxious except the tannin, which is extracted only by boiling or by prolonged infusion, whilst in the hydrostatic percolator the extract is obtained instantaneously, and by mere infusion and lixiviation.

The CHAIRMAN.—The Chinese simply pour hot water on the leaf, and pour it off immediately.

MR. LOYSEL.—Yes, but they have no war tax or duty on tea. I believe the flavour of tea properly made in this machine is superior to any extract in the tea-pot, especially if you draw it at once.

MR. LOYSEL then performed the process of making tea and coffee with his machines; and, in a very short time, made a large quantity of both beverages, which was served out in cups to the ladies and gentlemen present, who proclaimed it excellent.

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LECTURES.

Friday, March 2nd, 1860.

GENERAL SIR J. F. BURGOYNE, BART. G.C.B., in the Chair.

THE RIFLE AND THE RAMPART; OR, THE FUTURE OF DEFENCE.

BY CAPTAIN H. W. TYLER, R.E.

THERE are still a number of nice, dear, old ladies in this country—long may they live in it!—who consider steam engines and railways as nasty, dangerous things, who believe that people have no right to be whirled through the air at the awful speeds of the present day, and who are firmly resolved not to place their valuable lives, at all events, at the disposal of any board of railway directors. It would answer no good end, of course, to talk to these otherwise sensible persons, of the enormous results which these "new-fangled machinations" have already produced, any more than of those which they are destined to bring about, in the different relations of mankind.

In like manner, there are many distinguished members of the sterner sex, younger in years, and military by profession, who look through a veil of prejudice at the improvements which are taking place in the weapons of war. They cannot but consider rifled muskets and guns, and elongated projectiles, to be nasty dangerous things; but they are convinced, nevertheless, that they will not produce, after all, much alteration in the actual practice of war. They regret to see such weapons being introduced into the service. They fear that the relations which have previously existed, and which ought in their opinion still to be maintained, between the three

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arms, are in danger of being disturbed. They foresee that soldiers will be shooting at each other from long distances, and throwing away their ammunition, without achieving decisive results. It would be an equally thankless task to discuss with them the possible effects of these improvements, and still more so to dwell with them upon those interesting reflections, as to the power which the possession of such means of destruction confers upon civilisation, and upon the helpless condition in which barbarism will, in the end, be relatively placed.

I cannot, of course, suppose that any person holding views of this description would take the trouble to come here to-day; but I am happy now to have an opportunity of endeavouring to fulfil towards those who have done me the honour to attend, the promise which I made in this place on the 1st of April in last year.

There have been two great changes since that time in the military prospects of this country, for which we have to thank,—no apprehensions excited by vain threats or empty menaces,—but the actual demonstrations and preparations of the Emperor, our neighbour.

I took that opportunity of strongly advocating, as others had done before me, the establishment of volunteer corps; but I little thought how soon that movement was to commence, which has since taken root, has sprung up, has shot its branches over the length and breadth of the land, and has already so abundantly brought forth fruit.

But, as a general law of nature, rapid growth is followed by quick decay. A man forgets most readily that which he learns most easily; and values least what he acquires with the smallest difficulty. In vegetable, as well as in animal nature, short endurance follows upon rapid growth, as an almost invariable rule. In the establishment of empires, or in the alterations of their constitutions, the same law holds good. And what we have principally to fear with regard to our rifle movement, is, that it has come to us in a storm too violent to last, and that it will dwindle away after the occasion has passed away by which it was immediately called forth. There is not much fear of this, however, as long as the political horizon maintains its present threatening aspect. A great point will have been gained, when once military organisation, military discipline, and proficiency in the use of the rifle, have acquired a firm footing in the civil ranks of life, and particularly when they are recognised as a useful element in the education of the youth of the country.

The second measure that has been happily effected, is the appointment by the Government of a Royal Commission to consider and report upon the important question of National Defence. We are now anxiously expecting to have an opportunity of seeing the Report of that Commission, and of ascertaining how they propose to expend those ten millions of money which have been so much talked about.

This is a large sum; but our Houses of Parliament have cost a quarter of it; the fortifications of Paris alone have been estimated to cost, altogether, 8,000,000 pounds sterling; and if we can place ourselves, as far as our fortifications are concerned, in a condition of security for something approaching to that amount, we shall do well. The prosperity of this country depends upon its commerce. The parent of commerce is confidence. By a judicious system of permanent works, and by a wise expenditure of

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money amongst our own population, we may fairly expect to purchase an increased feeling of stability with regard to our country and its institutions, at home and abroad, in time of peace and in periods of war, which will have more than a money value; we may hope to avoid those occasions of panic which have recently been too much in fashion amongst us; and we may feel confident, that there will be an augmentation to the capital of the country, which will cause such a sum, great as it is, to appear even small by comparison.

Now, the expected possession of a force of 100,000 * effective volunteer riflemen and artillerymen, and the probable expenditure of a large sum of money upon fortifications, have an important connection, both with our subject of to-day and with each other. Twelve months ago, it appeared to be useless, if not worse than useless, to construct permanent works on a large scale for the defence of the country. It was clear, that, in the event of an invasion, when they would have been most required, we must mainly have garrisoned them at the expense of our army in the field, from which not a man could have been spared. At that time, when it appeared so unlikely that we should obtain, either the money required for the construction of necessary works of defence, or the garrisons with which to man them, it was impossible to take that interest which we feel at present in the details of the question.

But circumstances have most materially changed. We could not have better garrisons for our works than effective infantry and artillery volunteers; and no better situation for the action of a proportion of these volunteers could be presented, than behind the parapets which are about, we will hope, to be constructed. In such positions, they would not only be themselves of essential service, but they would also liberate nearly the whole of the regular troops and militia for active service against the enemy.

Seeing then, that there is now a fair prospect, both of works for the defence of the country and of garrisons to put into them, we may proceed, with a practical object in view, to consider the principles upon which those works should be constructed.

Military tactics and the science of fortification are alike dependent upon the weapons employed. The former must always be guided in its rules of action, the latter in its principles of construction, by the effects of those weapons; but alterations in tactics may be effected by degrees. In field operations, experience, however dearly bought, may be gradually acquired. A general who best foresees necessary changes, and troops who are best prepared for them, are no doubt possessed of great advantages, and must, *cæteris paribus*, be in the first instance victorious; but still, commanders and troops may all learn from one another, and may more or less modify their movements and their operations, from time to time, according to the lessons which they receive.

With fortifications the case is different. The engineer is required at once to construct new works which shall be well adapted to future circumstances. He has nothing to guide him but his own studies and reflections, and such applications as he can make of the experience of the past to the probabilities of the future. He is called upon to lay out works which shall be available

* Since happily swelled to 150,000, and upwards.

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for future generations, as well as for his own time; and he is expected to adapt his works for the use of, and for defence against, weapons whose powers are as yet but imperfectly known.

It is not indeed of such importance as it would appear to be at first sight, that he should be acquainted with the precise effects of the weapons which are being introduced. He must not limit himself too narrowly to the consideration of the powers which have been displayed by them up to the present time. He must so contrive his works, as far as in him lies, that they may best be prepared to resist the effects of these weapons, and to be defended by them, when they are brought to the greatest perfection which they can be expected ultimately to attain, in penetrating into, or destroying, iron, masonry, and earthwork.

In discussing these very important questions, I propose, to commence with a brief sketch of the history of fortification up to the present time, to consider next, what effect improved weapons may be expected to produce on the works now existing; and to suggest, finally, certain principles of construction which appear to be well adapted for future employment.

The object of fortification, as every one knows, is to enable an inferior to resist a superior force; and the means now employed to attain this object, are similar in kind to those which were made use of in the earliest ages. For more primitive and less durable works, earth and timber have always been available; and earthen mounds, wooden palisading, abattis, wicker-work, and so forth, were accordingly turned to account. For works of a more permanent character, and for those intended to be secure against escalade, superior positions were generally selected; walls or ditches, or both, were combined with such natural obstacles as these positions afforded, with a view to the shelter of the defenders, and the destruction of their enemies.

The science of fortification at the present day consists, in like manner, in the choice of suitable sites, where opportunity for choice is given; in the judicious application of mounds, walls, and ditches, to particular situations; and in their adaptation to modern weapons, of which they ought equally to resist the effects, and to facilitate the employment.

Examples illustrative of ancient fortification are shown at figs. 1, 2 plate I., and fig. 1, Plate III. In the first of these figures may be seen a wall, with a ditch in front of it, and a parapet on its summit. In the second is shown a parapet, advanced forward, as it were, on the top of the wall. This advanced parapet afforded a means of discharging missiles, not only from the opening A, in the top of the parapet, but also from that marked B, through which the ditch and the bottom of the wall were seen. A chamber, such as is shown at C, was sometimes constructed also on the level of the ground, and missiles were projected from it to the front. These walls were from 30 to 100 feet high, and from 6 to 12 feet thick. They were constructed, sometimes with brick laid in mortar or bitumen, sometimes with stones of enormous dimensions.

The way in which the walls were disposed in plan, is shown in fig. 1, Plate III., together with the towers, which were added, for strengthening and defending them. They were from 70 to 200 paces distant from each other, and were chiefly round; but they were sometimes square, as at Pompeii, and sometimes polygonal. They varied in height. At Carthage

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they were 60 feet high, 15 feet above the walls. At Nineveh they were 100 feet higher than the walls, and they measured altogether 200 feet from their bases to their summits. They were commonly 30 or 40 feet in diameter.

At Jerusalem, Carthage, Rhodes, and other places, double or triple walls were employed, for greater security; and at Ecbatana, the capital of the Medes, there were seven walls. The outer one, two or three miles long, was white; the second was black; the third, purple; the fourth, blue; the fifth, red; the sixth, silvered; and the seventh, gilded. Each of these was higher by its battlements than the one in front of it, and the whole must have furnished an astonishing example of luxury in fortification.

I should not omit to mention here, also, the walls of Great Britain and China.

The former, 12 feet high and 8 feet thick, was constructed in the beginning of the third century. It was 74 miles long, with battlements 4 feet high, and was defended by means of 18 stations, about 4 miles apart, each accommodating 600 men; 81 castles, less than a mile apart, each garrisoned by 100 men; and 330 watch-towers, or turrets, each containing a few men. The latter, 20 feet high, and 14 feet thick, was built upwards of 400 years before. It was armed with towers 80 or 100 yards apart. Both of these walls were carried directly over all the obstacles that came in their way.

In the middle ages, the ponderous machines of the ancients were less used, though they were employed during the Crusades; and there were no such fortresses constructed as we read of in the records of earlier times, either in point of extent or of solidity. Cologne, and modern Jerusalem, are the two best examples of mediæval fortification. The walls of the former have been utilised in the works constructed in the present century, which now surround the city; and they are familiar to the English tourist, as well as the castles on the Rhine, and in other places. In our own country there are many exceedingly interesting specimens of mediæval fortification. Amongst them may be particularly mentioned the castles and walls, so well known, of Conway, Carnarvon, and Ludlow. The first of these has round, the second octagonal towers; and the third is surrounded by towers of various forms. The castles of Edinburgh and Stirling, like those of the Rhine, are remarkable for the sites on which they have been constructed.

But, even now, there are lessons to be learned, both from ancient and from mediæval fortification, which should not be despised. In modern fortresses, too much dependence has often been placed upon one defensive line, and the forcing of that one line has frequently led to the capture, or surrender of the place. Unprovided, even with posts of security along that line, fortresses have not only been lost, but the inhabitants have also been delivered over to the excesses of their infuriated assailants, on the occasion of a surprise, of a coup-de-main, or of the storming of a breach.

The ancients provided against such a contingency, partly by rendering their towers independently defensible, and, still better, by the numbers of walls which they constructed one within the other. The architects of the middle ages attained a similar object by their citadels and keeps, or by fortifying the houses within the walls which surrounded their towns.

The want of permanent internal works of an analogous description, also, has caused the surrender of many a fortress in modern times, after the for-

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mation of a practicable breach, or of one supposed to be practicable, for fear of the consequences that an attempt at prolonged resistance would be likely to entail; and in the present century many plans have been adopted, and very many have been proposed, for remedying the defect that had thus been allowed to creep into the science, and that had been found by bitter experience to be attended with such serious results.

The first shot that were employed, after gunpowder came into use, in the middle of the fourteenth century, were of stone; and these were not very destructive to exposed masonry. A solid tower, at the first siege of Magdeburg, was struck by upwards of 1500 of such cannon balls without receiving material injury. But iron shot proved, at length, to be so formidable that it was found necessary to sink the walls below the surface of the ground, and to hide them from the view of the enemy. From this time forth, fortification became more and more complicated and difficult; and, if I may use a very simple expression to describe an important principle, it grew to be a game of "hide-and-seek" between the attack and the defence. Walls continued to be, as they still are, in positions where wet ditches are not available, the principal means of security against sudden assault; and one of the leading questions, perhaps the greatest question, that the engineer has since had to solve, is, the best method of disposing his walls, so as to render them available for the objects required, and to place them, at the same time, out of reach of the artillery of the besieger. On the other hand, from the very commencement of a siege, the principal object of the assailant, next to that of forming a covered road, by means of which he may approach the place securely, is to destroy a portion or portions of the wall which prevents him from getting into it.

In order to adapt the walls of fortresses to the use of cannon on the part of the garrison, several changes were found, also, to be required. A larger base was wanted behind the walls, and in the towers, on which the guns might be worked. An earthen, instead of a stone, parapet became necessary, as it was found that the latter was soon destroyed, and that the splinters from it were more hurtful to the defenders than the enemy's shot. The wall itself, as I have already stated, had to be sunk to a lower level, to protect it from distant fire; and, the parapets and ramparts having been thickened, loopholes and machicoulis, in the ancient method, became inapplicable. In many cases, spaces were left between the earthen rampart and the wall, as in the "chemin-des-rondes," afterwards adopted by Montalembert and Carnot. But, generally, a necessity was felt for a better description of flank defence, in order to prevent the employment of explosive mines in the ditch, for blowing up the escarp walls; or the use of ladders, for surmounting them, out of the view of the defenders.

These considerations were at the base of all the methods of construction adopted for the improvement of fortification. And in the modes of the first writers may be recognised, as we shall see, the germs of the discussions, and even of the national predilections, of the present day.

The most noted of the Italian architects of the fifteenth century who paid attention to military engineering, was Francisco di Giorgio Martini. He was born in 1423, and is supposed to have died in 1506. He employed not only the more elementary portions of permanent fortification, such as the bastion and the curtain, but, also, the ravelin, the faussebraie, the covered

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way, and other works which have since been re-invented over and over again, and ascribed, at different times, to more recent authors. One of his designs, a copy of which may be seen in the second volume of the Corps Papers of the Royal Engineers, contains the ideas which have been carried out in the present century in Germany, of a polygonal trace with caponier defence.

The origin of bastions is now involved in obscurity. They are said to have been first used by a Turkish general, at the siege of Otranto; and it has been supposed that the idea of a bastion was first given by a square tower placed obliquely for flank defence against a wall, in the manner shown at K in Plate III. fig. 1. The first large bastion is stated to have been built at Turin, in 1461; and San Michaeli constructed that of the Madeleine, at Verona, in 1527.

Tartaglia and Marchi followed in Italy. The former has generally been erroneously supposed to be the inventor of the covered way. The latter claimed the invention of 161 systems, and gave all the outworks of more modern systems. His writings were commenced in 1546, and were printed in 1599.

The first German author on fortification, was the celebrated engraver and painter, Albert Dürer, who published, in 1527, the work entitled, "Underricht von Befestigung der Stett, Schloss, und Flecken." For permanent works, he proposed, in the first instance, round bastions of huge dimensions, in lieu of the old flanking towers. His embrasures for artillery were nearly on a level with the bottom of the ditch, and were provided with shutters, loop-holed for small arms. After finding that the expense of the enormous works which he proposed to build in masonry, would be too great, he devised earthen ramparts and escarps, with openings below for artillery. His circular system contained a double enceinte of masonry, with caponiers for the defence of the ditches, and is shown in profile in Plate I. fig. 3. His system on a square consisted of three earthen ramparts, one behind another, such as have recently been proposed by Mr. Fergusson in this country: the interior rampart was 60 feet high, and was flanked by caponiers. He provided casemates for guns, bomb-proofs for troops, and an independent defence for his bastions; precautions, the necessity for which was at first exaggerated, but which were afterwards too much neglected.

San Michaeli also built in the first instance, round, casemated flanking batteries for the service of guns, in some parts of Italy; but he afterwards constructed, in preference, low flanks, retired behind orillons of masonry, which were rounded at their extremities to resist artillery fire. The fire of shells at high angles of elevation was at this time coming into frequent use in sieges, and was demonstrating the necessity for placing men and guns under cover; and these two men, in their respective countries, naturally adopted the means which seemed best adapted for such a purpose.

A German author, Speckle, published a work on the "Architecture des Forteresses," in 1589, when fifty-three years of age. He asserted that he could give upwards of fifty different methods, all of them good; but he refrained from describing more than eight. He made, however, great improvements in the science, and forestalled the inventions of many of the engineers who came after him, as he also borrowed some from those who went before him.

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He increased the size of the bastions. He recognised the importance of placing the flanks at right-angles to the lines of defence, which the Count de Pagan got credit for half a century afterwards. He added casemated galleries, after Dürer, to obtain a low sweeping fire through the ditches, and prevent the action of the miners. He enlarged the ravelins, a measure for which Cormontaigne received praise 140 years later. He increased the places of arms; an improvement which Vauban subsequently made in Pagan's system with great *éclat*. He employed the fausse-braie. He proposed those counter-arched revetments which were afterwards invented and claimed by Du Vivier, Coehorn, and Trincano; and which are now considered to be the best form of retaining walls that can be adopted. He used triple flanks, which were afterwards adopted by others, and notably by Choumara in the present century.

In his publication of 1564, Castriotto advocated large bastions with triple flanks, and with caponiers. He proposed also a system similar to those which were afterwards constructed by Vauban, and were called the second and third systems of that eminent engineer.

In 1594, the first French author on fortification, Erard, de Bar-le-duc, published a work in which he advocated a modification of the Italian methods; but he was far from happy in his ideas, for, in his desire to protect his flanks from the fire of the enemy, he rendered them all but useless for the purpose for which they were intended, of defending the escarps and ditches.

Marolois reduced to a system, and published in 1627, the Dutch mode of fortification, with earthern ramparts and broad wet ditches. The third system of Coehorn, who has been termed, in consequence of his eminence, the Dutch Vauban, is shown at Plate III. fig. 6. Coehorn's last writings were published A.D. 1741.

Italian engineers came into great request in the 16th century in Spain and the rest of Europe; and their bastioned systems were generally adopted, though with various modifications. They were constructed at first with small bastions and long curtains; and the ditches were defended, according to San Michaeli's method, by low, triple flanks, protected by orillons. The existing fortifications at Berwick-upon-Tweed, though unfinished, and in a ruinous condition,* are an interesting example of the early Italian systems: an illustration of the principles on which they were designed may be seen, in plan on Plate III. fig. 2, and in section on Plate I. fig. 4.

Casemates fell into disuse after a time, on account of their expense, and the alleged difficulty of ventilating them; and the question of casemates *versus* no casemates, has continued to be much discussed, even in the present century. The French, adopting the views of the Italian engineers, assert that the Germans employ these auxiliaries too much; and the Germans, on the side of Dürer, accuse the French of not making sufficient use of them. The Germans employed casemated cover for large proportions of their garrisons in their fortifications of the 16th century, as at Küstrin and Spandau; and they have latterly done so to a still greater extent. The French have not, until recently, availed themselves so much of permanent

* It is said that the modern fortifications at Carisbrook Castle, in the Isle of Wight, also constructed in the time of Queen Elizabeth, are similar in plan to those at Berwick-upon-Tweed.

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cover in their fortresses, but they appear to have seen the necessity for it of late years. As an illustration of their more recent ideas in this respect, I may mention, that the fort of Mont-Valerien, near Paris, contains complete bomb-proof accommodation for 4,500 men, with their stores and materials. National character, as I have already hinted, has no doubt had much influence in producing the differences in theory and practice which have existed between the French and German engineers on these subjects.

Fortresses, however, in the sixteenth century, required to be modernised rather than to be constructed; and, accordingly, bastions were added in front of the old walls and towers, and demi-lunes, or semi-circular works, were placed in front of the gates of the towers and cities. These latter came to be considered, before the middle of the seventeenth century, as integral parts of the bastioned systems. San Michaeli was thus employed to modernise the fortifications of his own country, but his best-known works can hardly be said to have been of permanent utility to it; and they do not in this respect afford a good example to the advocates of the science. He would, perhaps, have preferred to leave his native city, Verona, without bastions, and his *chef d'œuvre*, fort Lido at Venice, unconstructed, if he could have looked forward into futurity, and foreseen the work that they were destined to perform. It will be remembered, that these very fortresses, instead of affording a means of defence to Italians, have, in their modified condition, actually preserved the Austrians, during the past year, from Italian liberators and their allies.

It will be impossible, within the limits here prescribed, to attempt to allude to more than a very small proportion of the systems of fortification that have been put forward during the last 400 years. It has been stated that there are upwards of 500 of them, and it is probable that that number is by no means an exaggeration. Deville, the next French author on the subject, (after Erard,) was not more successful than his predecessor. The first French systems worthy of notice, were that of Marshal Count de Pagan (shown at Plate III. fig. 3), and those which have been called after the great Vauban, and designated as his first, second, and third systems. But this latter engineer, though he constructed 33 fortresses, and strengthened 300 others, invented no systems himself, and disclaimed having done so. He adopted and simplified the ideas in fortification which were handed down to him, and applied them, as best he could, to the different places which it became his duty to fortify. His first system (Plate III. fig. 4) is perhaps better known than any other. It was taken by his followers as the average mode of construction which he employed at several places. It consisted simply of a bastioned front, with a ravelin and tenaille, (and caponier, when the ditch was dry,) in the ditch; and a covered way behind a sloping glacis. He placed the flanks at right-angles to the lines of defence, an invention which has generally been ascribed to Marshal Pagan, the distinguished French author (of the seventeenth century) above referred to, but which appears to have been due to Speckle, a German author, to whom I have also alluded, as having written half a century before his time.

The tenaille, which was constructed in the main ditch, in front of the curtain, to protect the escarp of the curtain and flanks, has been ascribed to Vauban, but it was previously invented by Castriotto in 1564; and it was somewhat after the fashion of the middle flank of Rimpler, 1673.

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The ravelins were originally intended to protect the principal entrances to the place, and were made in the form of a crescent. They received for this reason the name of demi-lune, which they retain to this day amongst the French. Straight faces and ditches were afterwards given to them, in lieu of their semicircular fronts, in order that the ditches might be better protected by a flanking fire from the main ramparts, than was possible when they were curved. The want of a covered way was conspicuously shown in 1529, at the siege of Vienna, when the Turks forced the garrison, after they had made a sortie, into the ditch. This work was mentioned (after Martini) by Tartiglia, in 1546, and is said to have been first adopted in the Castle of Milan.

The so-called second system of Vauban, is taken from the fortifications which he constructed at Belfort and Landau; the third, which is very similar to it, and which is given in Pl. III. fig. 5, from those of Neuf Brisack. In these he employed detached bastions, with "tower-bastions," as they have been termed (T T in the figure), connected together by a curtain behind them. At Neuf Brisack he broke up the curtain, in the manner also shown in the figure, to obtain a better flank defence. The ideas of detached bastions and broken curtains were published by Castriotto in 1584, and by Marchini in 1599. Zanchi was, however, the proposer of the true tower-bastions, those of Castriotto having been round.

Cormontaigne and others, after the death of Vauban, which occurred in 1707, took his first system as the basis for further improvement; but Choumara, writing in the present century, considers this to have been a mistake. It is said that they rejected the tower-bastion method, in consequence of its not having proved successful during the defence of Landau in 1713. After several others of the same name, the French engineers arrived at a system which bears to the present day the name of the modern system. It is shown in plan, in Plate III. fig. 7, and in profile, in Plate I. fig. 5. It had a ravelin of greater size and saliency than that of Vauban, in order that the besiegers might be delayed in their attack on the covered way in front of the bastions, and might find it more difficult to enfilade the faces of the bastions. There are, as will be seen by the diagram, a large redoubt in the ravelin, and a ditch, or *couppure*, across the faces of the ravelin, to prevent the besiegers from passing, without impediment, by sap, along those faces, and taking the redoubts which are placed in the re-entering places of arms, in reverse. A permanent intrenchment to the bastion, also shown in the diagram, was added by Cormontaigne, in order that, when the bastion was breached by the besiegers' artillery, from the counterscarp opposite the salient of the ravelin, the interior of the place might not be thrown open, or its safety be dependent upon a temporary intrenchment, thrown up under circumstances of difficulty, and under the enemy's fire.

Such are the principal features of the last "modern system;"—a system which has many serious defects. Its long lines, projecting towards the country, are liable to be enfiladed, including the faces of the ravelin and its redoubt, the flanks of the bastions, and, at times, even the faces of the bastions. It is wanting in secure casemated fire for the defence of its ditch, as the flanks of the bastions, which constitute its principal means of defence, may be counter-battered by the besiegers, even from a distance. It is expensive to construct, and affords no bomb-proof accommodation for its

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garrison. The masonry, as will be seen by its profiles, (Plate I. fig. 5,) is only of use in affording security against escalade as long as it is uninjured. The shoulders of the bastions may be breached from the salient of the ravelin; and certain portions of the ditch, in front of the curtain and the tenaille, are unprovided with defence, as they cannot be reached by the fire of the garrison.

Various means have been proposed for the remedy of these defects, by Bousmard, Chasseloup-de-Labat, Noizet, Dufour, Choumara, and General Haxo.

The detached ravelins, casemated tenailles, and bastion retrenchments, of Chasseloup and Bousmard, have, no doubt, merit; but, for the curved faces and flanks of the bastions of the latter, the same cannot be said. A diagram of the system proposed by the latter author will be found at fig. 8 of Plate III. The two main principles advocated by Choumara, of an interior glacis in front of the escarp, and of rendering the parapets and escarps in certain cases independent of each other, might to some extent be advantageously adopted in any future employment—if it were desirable—of the bastioned systems, and may be made available in other systems. The latter principle has been adopted to a limited extent in some of the forts which are now being constructed in this country. A glance at Plate IV. fig. 14, will show that the face A B, and the ditch before it, have been drawn—not parallel to one another, as they would have been made according to previous ideas—but each in the direction considered to be most suitable to it. The face is intended to deliver its fire to the greatest advantage over the country in its front; the ditch, to be flanked by the caponier at the salient of the work. In figs. 11, 12, 13, 14, of Plate II. may be seen the different proposals of the same author for improving the profiles of his works, which are suggestive, and worthy of consideration, though they are not, for the most part, applicable in practice. The interior glacis is shown in Plate II. fig. 12.

The closing of the opening in the main ditch, caused by the ditch of the ravelin, by means of large redoubts at the re-entering places of arms, as proposed by Noizet and Dufour, is an obvious mode of remedying that defect. The casemates of Haxo, which consist of brick, or masonry arches, covered with earth, thrown over the guns, have already been much used, and are probably destined, with modification, to be extensively employed in future works.

But changes of a more radical nature than those above indicated, have been advocated by the illustrious Marquis de Montalembert, and by the celebrated Carnot, who were brought up, the former as a French dragoon, the latter as a French engineer; and it is right to add, that the ideas of the engineer were in some measure derived from the writings of the dragoon.

Montalembert expended a great part of his private fortune in the publication, in 1776, of the elaborate work, a copy of which, belonging to the library of the Institution, you see before you. Carnot was employed by Napoleon to devise the best means that he could, for improving the strength, and prolonging the defence, (in case of attack,) of the numerous fortresses which the French had acquired in the course of their conquests.

The leading principles of Montalembert were:—first, the employment of a central caponier, in lieu of the flanks of the bastions, for the defence of the

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main ditch,—a method which was alluded to in an anonymous work published by Pfeffenger at Amsterdam in 1698, sixty-eight years before, as having been then practised; and, secondly, the multiplication of masonry casemates, and artillery fire. He proposed by these means to correct the acknowledged defects of the "modern system," and, by bringing ten guns to bear upon any one which the besiegers could employ against him, to render a siege impracticable. Montalembert thus estimated with too liberal a mind the offensive means which it would be practicable to place at the disposal of his garrison; and he undervalued the effect upon masonry, of even an inferior fire on the part of the besiegers. A profile of his circular system, illustrative of the mode in which he proposed to carry out the latter principle in that system, is shown in Plate I. fig. 6.

Carnot proposed several systems, including a circular system, as many others,—Dürer, 1527; Bilfinger; Franki; Steuber; Pirscher, 1767; Schneider and Cugnot, 1778; Lansberg, 1712—37; Voigt, 1713; Harsch, 1719; and Montalembert, 1793,—had done before him. His leading idea was, to prolong the defence of a fortress by an increased use of the vertical fire of mortars, from which he intended to shower musket-bullets upon the heads of the besiegers; and, either to destroy them, or to render their trenches untenable. He proposed to protect his mortars by casemates, after a plan which had been given by Speckle in 1589. Secondly, he placed a detached wall in his ditch, separated from the ramparts, and covered by a counterguard of earth in its front. Thirdly, he advocated the use of a countersloping glacis, to facilitate sorties; an old expedient of Belisarius, when he was besieged in Rome by the Goths. Carnot proposed, by the frequency of his sorties, to oblige the besiegers continually to keep large bodies of troops in the trenches; and he intended to destroy those troops by the fire of small projectiles, which were to be continually rained down upon them from his mortars.

These were formidable arrangements, but they were not calculated to be successful in practice. It has been shown by Sir H. Douglas, that Carnot over-estimated the probability of hitting the besiegers with his showers of small bullets; that, even if he had been able to strike them as frequently as he expected, he would not have done them much harm; that, at all events, a leather or wicker helmet would have protected them from their effects; that he would have exhausted any moderately numerous garrison by a too frequent employment of sorties; and that his detached wall was not secure against the distant fire of the besieger. A profile of Carnot's third system is shown at fig. 7, Plate I.

These principles of Montalembert and Carnot have been extensively adopted in the fortresses which have been constructed in Germany during the present century.

There is an excellent model of the "Prussian System" in the Military Model Room of the Institution; but, for present reference, there will be found in Plate II. figs. 8 and 9, illustrations in section; and in Plate III. figs. 9, 10, 11, illustrations in plan, of the polygonal systems adopted by the Germans from the ideas of Montalembert, showing the central caponiers, the detached walls, and the countersloping glacis, to which reference has been made.

The German engineers, themselves, have told us but little about their

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works; and they guard the entrances to them with a care which deserves a better result than they have obtained; but other nations are well provided with plans and sections of them, and have acquired a considerable amount of information about them. To obtain the requisite knowledge, it is stated that two French engineer officers worked as stonemasons at Fort Alexander, at Coblentz, for some months. The best account of that fort has, however, been given by an English officer, Colonel Humphreys, who resided for some time in the neighbourhood.

The principal German fortresses that have been constructed, or remodelled, since the peace of 1815, are:—in Prussia, at Coblentz, Cologne, Posen, Thorn, Königsberg, and other places; in Bavaria, at Gemersheim and Ingoldstadt; by the German Confederation, at Mayence, Rastadt, and Ulm.

In the construction of these fortresses, casemates, for artillery fire and bomb-proof cover, are extensively employed. By a multiplication of tiers of guns, greater offensive power is in some cases aimed at. The polygonal trace is adopted, in which the forms of the ramparts approach nearer to straight lines than in bastioned systems. The main ditches are defended by casemated caponiers, either separated from, or attached to, the body of the place. Advanced works are placed in front of the principal lines of defence, to command a greater extent of ground, and to delay the besieger. The ditches of these advanced forts are flanked by caponiers, bastionets, or escarp or counterscarp galleries, as well as the smaller ditches of the main fronts. Defensive, bomb-proof barracks, of proportionate size, are added in the rear of the larger, and bomb-proof redoubts, of more limited dimensions, in rear of the smaller works. The use of countermines has been extensively adopted, and most judiciously so, because, wherever they exist, they compel the besieger to approach the works attacked by very slow degrees. Each smaller work, and each portion of the larger works, is designed with a view to independent defence; and they are all, more or less, combined in a system of general support, so as to favour an active defence.

Whatever the defects of the German works, this last principle, at all events, is a highly important one, and is greatly to be commended.

A *step-by-step* resistance is aimed at, increasing in efficiency in proportion to the strength and resources of the garrison. I shall have occasion to point out presently, how the masonry may in some cases be ruined from a distance; and that this is a defect which should be remedied. But the idea is not the less good, and is the same that has been advocated notably by Choumara, in reference to bastion fronts. It is this—that the besieger should be delayed by successive obstacles; that after approaching one, by the slowest process of sapping and mining to which he can be reduced, he shall have to do the same by the next, and the next, and so on, to the defensive barracks in the interior of the main fortress.

These principles are differently applied in the various fortresses referred to, partly to suit the situations and circumstances of each particular case, partly to adapt them to works previously in existence, and partly, as it would appear, to suit the ideas of those by whom they have been constructed.

It will not be possible now to go in detail into the question of their various adaptations, or their relative merits; but I will just refer briefly to

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Verona, as having been of recent interest, and to Lintz, as being an exceptional fortress of an extraordinary character.

At Verona, detached walls have been added to the original bastioned trace, with a counterloping counterscarp opposite the curtains; and round towers of masonry have been placed in advance. It was reported towards the close of the late war in Italy, that the Emperor of the French proposed to carry Verona by assault. This would not have been practicable without the previous action of artillery; but it is probable that he intended:—1. To ruin some of the masonry towers in advance of the place by means of his rifled guns; 2. To breach the detached walls, by the method shown in *Plate II. fig. 17*, and to batter the earthen slopes, of the main rampart; and, 3. To attempt to carry the main defences by assault. I shall say more presently, with regard to the practicability of the two first of these measures. In the meantime, I may remark, that the fortress of Verona, in combination with the other fortresses in its neighbourhood, certainly served admirably the purpose for which it was intended, that of receiving, when necessary, and giving protection to, a beaten army; and that, whatever the defects in the details of its construction, its position proved to be of the utmost advantage to the Austrians in the operations referred to.

At Lintz, masonry towers, invented by the Archduke Maximilian, have been constructed about a quarter of a mile apart; but, to render the position tenable by any garrison but a very large army, they require to be protected by earthwork, and to be connected together by continuous works. There is a most interesting model of Lintz, and the surrounding country, in the Institution, which has been contributed by Captain Stavely, late of the Royal Engineers; showing the position of these towers, and illustrating the strategical fortress which they are destined to form. The principal feature connected with the design of the towers is the arrangement of the gun carriages, by which the Archduke Maximilian expected to obtain a heavy concentrated fire upon any required point; but experiment has already demonstrated how easily the towers, in their present form, may be disabled, and how readily the guns may be silenced; and the construction of these towers cannot be considered in any other light than as a great, and an expensive mistake. Vast additional works must be undertaken in connection with them, before the position can be rendered formidable to an enemy; and their destruction would, in their present unprotected condition, be the more easily effected, now that rifled guns, capable of being worked and transported with increased facility, and firing at longer ranges and with greater accuracy, are coming into ordinary use.

In the fortresses above mentioned, what may be called the modern German principles of fortification have been more or less carried into practice. Time will not permit me now to do more than make a general comparison between the principles on which those works have been constructed, and those which have been employed of late years by French engineers; but such a comparison is, in fact, the great fortification question of the present day, and has formed the principal subject of discussion between continental writers. The Germans have adopted principles, as we have seen, that Frenchmen have advocated, but that are different from those on which French engineers have mainly acted. The French still uphold the bastionary, and assert that it is superior to the polygonal trace; while the Germans have

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applied the latter trace; and, in thus carrying out some of the suggestions of Montalembert, have met with more approval, and have been more followed in Europe generally.

The French, in fortifying Paris, employed, after much discussion, a continuous, bastionary enceinte, surrounded by advanced bastioned forts; and Paris may be taken as a type of modern French fortification.

At Grenoble, Belfort, Besançon, advanced forts have been added, and these places have been converted into vast strategical fortresses. At Lyons, the French have also used a bastionary enceinte, and have placed ravelins in front of it; but in some of their advanced forts at this place they have made use of a polygonal trace, with caponiers and interior redoubts, in a manner that has induced the Germans to claim them as partial converts to their principles.

The principal defects which the Germans, following Montalembert, allege to exist in the French bastioned trace, are briefly these:—

1. A want of artillery fire from casemates.

2. A loss of interior space, in consequence of the curtains being retired for so considerable a distance behind the bastions.

3. An unnecessary restriction to the length of the lines of defence.

4. An inferiority of space for direct artillery fire, as compared with that which may be obtained by the employment of the straighter fronts of the polygonal trace.

5. A want of good interior defence, and of the means of establishing it.

6. A liability in the parapets of the flanks to be destroyed before they are wanted, at the later periods of an attack, to defend the ditches.

7. A want of defence for certain portions of the ditch, when a tenaille is employed.

The French, also, assert that the following defects exist in the German applications of the polygonal trace:—

1. The casemates are too numerous, and cannot be properly ventilated.

2. The masonry would be destroyed at an early period of the operations.

3. It is expensive to construct.

4. The splinters from the masonry would be very hurtful to the besiegers when under fire, and therefore detrimental to the defence.

5. Employment in the casemates weakens the courage of the soldier.

6. The escarp walls are not flanked from the body of the place, but the defence of the ditches is obtained by means of caponiers, and works more or less separated from it.

7. The central caponiers might frequently be destroyed by distant artillery fire; and, even if they were battered from one side only, the defenders would suffer, in many cases, on the other side also.

8. The other flanking defences would also be liable, in many cases, to destruction from distant fire.

9. The detached Carnot walls, where these are employed, and other parts of the masonry, would suffer in a similar manner.

10. Longer lines are exposed to the effect of enfilade fire in the polygonal, than in the bastioned trace.

I shall have more to say on some of these questions as I proceed, further on, to consider how far either of the systems referred to are adapted for

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future use. In the meantime, you will observe that the principal questions between the French and German advocates, are—

1. The more or less extensive employment of casemated fire.

2. The relative advantages and disadvantages of bastions or caponiers for flank defence, and in other respects.

3. The relative liability of the polygonal fronts, or of the faces and flanks of the bastions, to enfilade fire; and the possibility of directing these, respectively, upon points from which they cannot be enfiladed.

You will observe, also, that they have entirely agreed, in their practice, upon one point. Whatever the forms that they have employed in their fortresses, they have surrounded their main lines of ramparts, in all recent cases, by detached forts; and they have, in their larger fortresses of recent construction, more or less abandoned the use of outworks in favour of these detached forts. They have thus alike made preparations for defending a greater area of surface with an increased use of artillery, at the same time that they have provided, to some extent, against the employment of more effective and longer-ranging weapons in the attack; and they have anticipated in this manner the progress of modern weapons, and the requirements of modern warfare. They have only done so, however, to a limited extent, because they were unable, of course, to foresee the degree of perfection to which rifled guns and muskets were destined so soon to attain.

At the same time, these modern fortresses show the general tendency of ideas to be now in favour of extensive strategical positions, in place of isolated fortresses of limited extent; and, when properly armed, manned, and provisioned, they will no doubt have great advantages over those of older construction. They are more or less fitted for the reception of a beaten army, which may take refuge in their neighbourhood, or within the area of their works,—which may gain time for recruiting its numbers and resources,—and which may resume the offensive at the proper moment. They oblige the besieger to commence his operations at greater distances from the main works, and thus delay the operations of his attack. By causing him to extend his forces over a greater surface, they compel him to employ larger forces, or to be exposed to attack himself, by superior numbers, at any given point.

I cannot now allude more particularly to the subject of fortification with wet ditches, or to the system of Mr. Fergusson, which has, within the last ten years, excited some attention in this country, though I hope to do so, in this place, on the 21st of May next.*

In the meantime, having glanced rapidly over the history of fortification, and having brought it down to the present time, I will next proceed to inquire what the effects will be, in practice, of these new rifled weapons, and what additional power they will be likely to confer upon infantry and artillery, as far as that science is concerned.

In the first place, it must be remembered, that their *maximum* effect will be made available, and will be experienced, in the attack and defence of fortified places. In the field, there will always be more or less of difficulty in obtaining, just when it is required, perhaps on unknown ground,

* The Lecture on this subject has been already printed, and will be found at p. 199, Vol. IV. No. XIII., of the Journal of R.U.S. Inst. *et seq.*

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the range of the objects to be fired at; and more particularly so when these objects, as is frequently the case, are in motion. The longer the range employed, the greater will be this difficulty; and when the range has been accurately discovered, the object fired at, such as a body of troops, may often be moved out of the way, into a place of concealment, or a position of greater security.

In this case, also, the aim of the contending parties will not be so good when cover cannot be found for men and guns. Artillery will be liable to suffer severely, both from sharpshooters and from opposing artillery; and masses of infantry will be under a similar disadvantage in the generality of cases.

But, in the course of a siege, besiegers and besieged are firing at each other on the same ground from day to day, for the most part at well-known distances, the artillery from behind parapets, the infantry from such shelter as the site affords, or from trenches and pits constructed for the purposes of attack or defence. Artillery and infantry will both require, and will no doubt obtain, better cover in future than they have hitherto been provided with; they will thus be able to employ their weapons from places of comparative security; and they will be placed under the most favorable circumstances that hostile operations can afford, for using the superior weapons which will be supplied for their use, with great accuracy, at long, as well as at short ranges.

The defence has hitherto had one advantage over the attack, in that the besieged have been able to employ guns of larger calibre, and thus to obtain longer ranges, and greater accuracy of firing, than the besiegers; but the introduction of rifled ordnance has deprived it of this advantage; and it will in future be desirable to employ, on the side of the defence, a greater number of lighter guns; these guns being now capable of almost all the range and accuracy that can be desired, being more easily manned and worked, and being available for more frequent use with a less expenditure of ammunition.

The heavier guns will now be principally required on the side of the attack, to level the earthwork, and to ruin the masonry of the place; whilst lighter guns will be employed by the besiegers, against mantlets, for silencing and dismounting the enemy's artillery, and, to some extent, for the purposes of enfilade and ricochet fire. Lighter guns will, for the most part, suffice, in combination with musketry, on the side of the defence, for opposing the progress of the trenches, the batteries, and, generally, all the surface works of the besieger; and they will only require occasional assistance from heavy artillery, when the destruction of any of those works, after their completion, or their partial completion, is to be attempted.

It is evident that, by the employment of rifled guns of the heavier calibres, the besieger will be able to destroy all the ordinary defences of a fortress that are exposed to his fire, with greater facility, and from greater distances, than before. We have still much information to acquire in regard to the relative penetration into earth and masonry, at different distances, of round and elongated projectiles; but we know the accuracy with which the latter may be thrown; and we can foresee, without difficulty, that the aggregate effect of a given number of shot will be materially increased, for this reason, at anything but short ranges.

Elongated missiles from rifled guns, though capable of greater range, by

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virtue of their increased momentum and greater accuracy, have at the same time, however, two disadvantages. They leave the mouths of these guns with a comparatively low velocity; and their long axes retain, during their flight, the angle to the horizon at which they are discharged. At short ranges, they are therefore wanting in velocity; and at long ranges, they strike the objects at which they are fired at a greater or less angle, according to the degree of elevation given to the piece. Their powers of penetration are thus less than they would otherwise be, both at long and at short ranges. They retain their velocity, however, better than short or spherical projectiles, at long ranges; and they can be made to strike a particular part of any object at far greater distances, and with much greater accuracy; and, for these reasons, they will be able to provide a distant fire of a more destructive character than any that has previously been employed, against ordinary works of fortification.

In breaching a wall at 60 or 80 yards from a battery, there will not be so much difference in the time occupied, whatever description of shot may be employed; and more will depend in that case, if the masonry be solid, upon the calibre of the gun, than upon the shape of its bore or the form of its projectile; such difference as there is being in favour of the smooth-bored gun. In firing at short ranges into earth-work, or into slightly built escarps, the superior shell-capacity of long missiles, will, on the other hand, be in their favour, as increased effects cannot but result from their explosions.

At what we have hitherto been accustomed to consider as long ranges, parapets of earth will then be more easily blown away by the accurate fire of shells, and masonry will be knocked to pieces with greater celerity and certainty, whenever it is visible from the exterior. Those effects, also, the besieger will be able to produce by means of guns scattered about in suitable positions in the neighbourhood of a fortress; secure, by their distance from the besieged, from sudden assault, more or less independent of the other works of the attack, and difficult to be silenced by the fire of the garrison, or even, in some cases, to be discovered, except by the flash and smoke of their explosions.

Improvements in manufacture, and in the means of locomotion and transport, are progressing together at so rapid a rate, that we must be prepared, not only for the action of superior weapons, but also for the employment of greater numbers of weapons; and the means of destruction at the disposal of the besieger will thus be still further augmented.

At the same time, the peculiarities above referred to, which attach to elongated projectiles, render them comparatively powerless against any material which is inclined at a small angle to the horizon; and gentle slopes of earth, as well as steeper slopes of granite, and perpendicular masses of iron, may be made to offer a good resistance to them when they are judiciously employed.

What I have hitherto said, has reference more particularly to those works of a fortress which are visible from the exterior; but I must now speak also of the masonry, which, not being visible to the besieger, may yet, when its position and form are accurately known, be exposed to the destructive action of his artillery fire.

In the year 1824, there were some experiments tried at Woolwich, upon

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a detached wall, such as had been proposed by Carnot, as I have already explained, for the defence of the ditches of fortresses in place of escarp walls The object of these experiments was, to ascertain whether a practicable breach could be made in a wall of this description without its being seen; and the nature of them will be easily understood by a reference to fig. 17, Plate II., in which the experiment is represented in section. A detached brick wall, 30 feet long at the bottom, and 28 feet at the top, was carefully built in 1823. It was 21 feet high, 6 feet thick at the top, and 7 at the bottom. It was strengthened by a buttress, four feet square at each end, and was weakened by one loophole, in a recess. It was protected in front by an earthen mound, in the form of the counterguard proposed by Carnot, 60 feet distant from it.

A year after the completion of the wall, eight 68-pounder carronades, at 500 yards, and three 8-inch and three 10-inch iron howitzers, at 400 yards from the counterguard, opened fire upon the wall, with solid shot, and live shells, respectively. A practicable breach, fourteen feet wide, was made in the wall, in six hours, and the buttresses were much injured. During that time, 100 rounds per piece, or, altogether, 1,400 rounds, were fired.

The firing was continued on subsequent days, until the wall was a complete ruin. It has been stated that this experiment was not fairly made, and that the effect of each shot was reported to the battery, to enable the elevation of the guns to be the better adjusted. But in the official report of it, published by Sir Howard Douglas, it is stated, that the guns "received no aid, as to charge, direction, or elevation, beyond what real service would afford."

A few years since, also, some experiments were tried in Germany, upon a casemated guard-house at the rear of an earthen work. The wall to be struck was 39 feet long, 15 feet high, and 5 feet thick; and it was strengthened at the ends by two side walls, 6 feet thick, and in the middle, by a pier, 4 feet square. It was pierced with two embrasures. The arches above it were 3 feet 6 inches thick, and had 5 feet of earth over them. The whole was built of clay-slate, laid in good mortar, except the arches, and the lining of the embrasures, which were of red brick.

It was protected by an earthen parapet, 108 feet in front of it, and 3 feet higher than the masonry of which it was composed; and it was thus itself concealed from view, though the earth above it could be seen by the gunners in the battery that was employed for the experiment. That battery was placed 530 yards in front of it, and was armed by iron howitzers, with a bore of 8·4 inches. They were discharged at an angle of elevation of 6¼ degrees, with shells weighing 101 lbs. each; and the wall was ruined, for practical purposes, after 400 rounds had been fired.

Lieut.-Colonel Bainbrigge, R.E., by whom this experiment is recorded, states that the effect of each shot was telegraphed during the experiment to the battery. The experiment was not a fair one in this respect, as the artillery had an advantage, in knowing the result of their firing, which they could not obtain in actual service; but, after all, the wall was only struck by 34 out of 112 shells, which were fired at it in two days; and the whole building by 159 out of 400 shells, which were fired at it in four days.

In the Woolwich experiment above referred to, only about one-fifth of

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the shot, and one-fourth of the shells, struck the wall; and, to give an idea of the weight of metal that is required to breach an ordinary escarp wall, when it is exposed to view, I may here state, that a rough average of the effect of the breaching-batteries in the Peninsular sieges, as calculated by Colonel Sir William Denison, R.E., shows an expenditure of upwards of 1,000 rounds of 24-pounder ammunition for a breach 100 feet long, made at a distance of 550 yards from the battery.

It would be, of course, far more difficult to ruin an escarp wall, and particularly one which was constructed with arches resting on piers distributed at intervals along its length, or in what is called the "counter-arched" form, than the detached wall destroyed in the Woolwich experiment; and the principal bomb-proof caponiers of the German fortresses would offer a far greater resistance than the guard-house of the work referred to in the German experiment; but there is no doubt, at the same time, that a far more accurate fire may ultimately be obtained from rifled artillery than was available on these occasions. To how great an extent this will be the case, time and experience only can decide; and, in the meantime, the only conclusion that we can safely arrive at, is, that it will nôt be desirable to construct any walls in future permanent fortifications, when we can avoid it, that are not well protected from distant fire; and that it will be a great advantage, if, without losing efficiency in other respects, or incurring extra expense, we can, not only conceal our walls from view, but also place them out of reach of any fire of this description.

In considering the possible effect of distant fire upon the main caponiers of the German works, there is another element to be taken into consideration. These caponiers have no parapet, or counterguard immediately in front of them. When a hostile battery can be constructed on the prolongation of the ditch that they defend, they have nothing to protect them from that battery but a counterguard, a counterscarp, or a countersloping glacis, some 200 yards distant from them. The comparatively low trajectory of rifled cannon would in this case come into play with good effect. The firing would be accurate, and the projectiles, discharged at low angles of elevation, would be very destructive. The inferior caponiers of the German fortresses, and all those caponiers or galleries for defending the ditches of the advanced forts which face outwards towards the country, along a ditch, whose prolongation can be taken up by the besieger, labour under similar disadvantages; and all the defensible barracks and guard-houses which they have constructed as keeps for their different works, will be more liable to suffer, in the way described, from the effects of distant fire, now that rifled artillery can be brought against them.

Both in the French and in the German systems there will be a liability to an enfilade fire of greater accuracy from longer distances; and the long lines of the latter, as well as the faces and flanks of the bastions of the former, will now be open to this description of attack in some cases in which they were previously secure from it. The ricochet of the elongated projectiles will be less regular, and lower, than that of spherical shot and shell; and it will not continue for any great distance on the line in which the projectile has been fired; but it will still be very formidable; and the projectiles will in many cases do more execution, in consequence of their not rising, after their first meeting with an obstruction, so high in the air.

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The parapets of the flanks in the French systems will be more easily ruined by distant fire, and there will be an increased necessity for the use of casemated fire for the defence of the ditches, both on this account, and in consequence of the greater exposure of such flanks to enfilade or reverse fire, in order that, when flank defence is required for the ditch towards the close of a siege, it may still be forthcoming. When these flanks have a tenaille in front of them, they cannot afford low casemated fire for the defence of the ditch; when they are unprotected by a tenaille, and are pierced for guns below the level of the ground, they will then be liable to injury from the besiegers' distant batteries, established on the prolongation of the ditches, in the same manner as the caponiers of the Germans, which have been above referred to.

These are the principal points in which works of fortification, as hitherto constructed, will be affected by the employment of rifled guns. The general operations of a siege will also be materially modified, in consequence of the common use of rifled muskets; and, both in attack and defence, the individual skill and enterprise of the sharpshooter will have an important influence upon the success of the operations, as well as the judgment with which light and heavy guns are brought into play, in proper numbers, for suitable objects, and at the right moment. When these different weapons are thus made available on both sides, the following will be the general course of the operations of a siege:—The besiegers will commence by throwing up distant batteries from the best position that they can select, and as near to the place as their means of concealment and communication will allow, though at far greater distances, in the majority of cases, than have hitherto been prescribed. They will be able to annoy the garrison, and to ruin their works (unless they are constructed on improved methods), from greater distances, and they will more or less subdue and keep under their fire, according to their resources, as compared with those of the place; but they will, nevertheless, have great difficulty in advancing their trenches, and in approaching the fortress, when an ample fire of musketry and light artillery is employed in the defence; and they will be compelled to commence their works at a greater distance from it, to excavate to a greater depth, to resort more to underground operations, and to confine themselves more to the hours of darkness, in their advance, than formerly.

The more distant operations of a siege are those which will thus be principally affected, but the later operations will also be liable to much modification. The common sap, as hitherto practised, will not be available, but will be necessarily superseded, partly by a slower, safer, more certain process of a similar description, and partly by mining operations, and by connecting together the craters formed by the explosion of mines. Mantlets, screens, and pits, will be more in request at most periods of the attack, and more perfect cover, with well built embrasures and blindages, will become more and more necessary in the attack, at the same time that analogous works of a permanent description, with an ample supply of bomb-proof cover, will be wanted in the defence.

So far there will not, perhaps, be very much difference of opinion amongst us. We shall further, most of us, agree, that the great improvements which have lately been made in artillery will require to be opposed by fortifications of a different character from those which have been hitherto employed;

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and we shall all concur probably in opinion, as to certain main principles which must be observed in the construction of new fortifications, bearing always in mind that they ought to be built, not only with reference to the present state of artillery and small arms, but also with some margin for the still further power which these weapons may acquire hereafter.

Such principles apply, of course, more or less, to previous, as well as to present and future times, but they have often been too little attended to. They cannot be disregarded in future without more disastrous consequences. Considered with reference to the future, they may be briefly stated as follows:—

1. The masonry of a fortress should be kept, not only out of sight, but also out of the reach, of the besiegers' distant batteries.

2. An ample supply of bomb-proof cover should be provided for men, munitions, and materials of all descriptions.

3. The ramparts should be subject to a minimum of injury from the besiegers' fire, and the parapets should be the least destructible that can be devised at a reasonable expense.

4. The several works and their various parts should be disposed in plan, with a view, first to a distant defence, and afterwards to a step by step defence, of the most prolonged and obstinate description, at the smallest cost, when they are intended to be capable of resisting a regular siege.

5. The flanking defences should not be exposed to destruction from distant artillery placed on the prolongations of the ditches.

6. The means of communication between the main works and the detached works, and between the detached works themselves, should be, as far as possible, secure and secret.

The manner in which these principles may best be carried out, is, however, a subject of great difficulty, and one upon which much difference of opinion is to be expected. I am going now to ask you to listen to the best conclusions that I have as yet been able to arrive at, as to the general form which permanent fortification should in future assume; but I am far from asking you to place any reliance upon these conclusions. On the contrary, I hope you will only receive them as first suggestions; that you will look upon them with great mistrust, and that you will believe in no more of what I advance than may appear, after mature consideration, to be correct, and practically desirable.

Now that long-ranging guns of great accuracy are to be used, it is evident that any works to be constructed for the defence of towns, dockyards, arsenals, or strategical positions, must be extended over a larger area; and now that increased facilities are afforded for bombardment, better means of protection against bombardment are wanted. With regard to towns, the simplest method of solving the difficulty is to leave them as much as possible *un*fortified—a measure which has long been wisely advocated. Where towns, dockyards, or arsenals *must* be defended, the additional extension required for the works becomes a serious element for consideration. It is true that detached forts can support each other, and be supported from the rear, at longer distances; but at the same time their numbers will have to be increased (excepting where the line to be defended approaches to, or is, a straight line), and in many cases the lines of defence in their rear, or the lines connecting them, or the continuous lines in their front, where such are

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required, will have to be constructed on a larger scale. It must also be remembered, that the possession of good communications, both between the detached forts themselves and with any supporting works behind them, is almost indispensable to the proper maintenance of such a system of defence. The increase thus required in the area covered by the works, and the necessity which thus exists for long communications, as well as the want of additional casemated fire and bomb-proof cover, and of countermines (as I shall presently shew), have a tendency materially to augment the cost of fortifications. Efficiency must be obtained. Without it all the expense incurred will be little better than thrown away. But economy, combined to the utmost with that efficiency, becomes now a great difficulty, as it is a great necessity, of the problem before us.

Fortification, as will have been already seen, divides itself into plan and profile; and, beginning with the desideratum which is at the head of our list, it will be necessary to consider how the profiles can be arranged, so as to secure the revetment walls from distant fire.

When escarp walls are constructed in the best form, and are backed with earth, and particularly when they are built *en décharge*, or in a series of arches with the piers at right-angles to the front, they are then not so liable to injury as the detached walls before referred to. There is, further, no difficulty in placing the rampart at a greater distance behind the escarp, so that damage to the one will not entail, of necessity, injury to the other, an objection which has constantly been urged against the profiles of the French systems. And, finally, by making the escarp wall, say, ten feet lower, it may be taken altogether out of reach of the distant fire of the besiegers, provided it be covered by a good counterscarp and glacis, not too far removed from it.

But by that means extra expense is incurred; and this, as I have said, must now as far as possible be avoided. When an earthen slope is employed in the place of the counterscarp, that again lays open the escarp, and renders it necessary to sink it to a still greater depth. It has been proposed as we have seen by Carnot, and the German engineers have extensively adopted the suggestion, to employ the counter-sloping glacis; but the escarp wall, or the detached wall, becomes still more exposed, where this plan is carried out, to distant fire; and the advantages of economy, and of facility for sorties, thus obtained, are in this case, to say the least of it, too dearly purchased at the expense of security.

There is another course, however, which is open to us. Instead of substituting an earthen slope for the counterscarp, and trusting to the escarp alone, we might do precisely the reverse. We might, in fact, abolish the escarp, and trust to the counterscarp alone, for a first line of security against assault. It is clear that no direct fire from the front can affect a counterscarp wall; and the ramparts would be secure from any sort of fire from the front, if the escarp were replaced by a mass of earth, sloping gradually from the embrasures to the bottom of the ditch, such as is shown in section in Plate II. fig. 15. The great condition to be fulfilled in carrying out such an arrangement, in a small work, or in a principal line of defence, is the very important one of rendering the counterscarp itself secure against escalade; and this might be done as follows:—

In the same figure the counterscarp wall is, say, 30 feet high, and there

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is an earthen slope 10 feet deep, near the foot of it. Eight or ten feet of earth, also, are placed on the top of it, and the counterscarp on the summit is revetted so as to form a smooth surface. There would be required for the descent of this wall ladders upwards of 50 feet long; and it may therefore be considered safe from an attack by escalade, when properly defended, according to the computations that have hitherto been employed, and as shewn by all past experience on the subject.

But it will hardly be necessary to make a counterscarp wall so placed of the height which is here indicated, though its dimensions would vary with circumstances. I shall shew how hopeless any attempt to carry it by a *coup-de-main* would be, after I have described the other works with which it is intended to be connected. I have at all events complied with the first of our desiderata, as far as this revetment wall is concerned; because it will be both out of sight and out of reach of the besiegers' direct fire.

But it must also be remembered, that even a counterscarp wall may have to be protected, in some cases, from reverse fire. Rifled guns will be able to project their missiles altogether over any moderate-sized fortress, and to take the defences on the opposite side of it in reverse; and therefore, any masonry to the rear of which the besiegers can get with their guns, within available range and in suitable positions, will have to be protected from reverse fire by earthen screens, or by judicious dispositions, such as can only be decided on with reference to each particular site.

The masonry and brickwork of a fortress may all be protected from direct fire in a similar manner, by being made to face towards the rear. The required barrack and other accommodation may be obtained, as it has often been obtained in former cases, though in a different manner, beneath the ramparts. For a citadel, for a main line of defence, for detached works, the same principle holds good. When required to be very strong, they may have higher walls and more extensive accommodation; when less important, they may have lower profiles; but they may all be protected in the same manner from assault, by means of one wall placed behind their glacis, and another behind their ramparts.

By this method of construction, the objects referred to in the two first headings on our list are well attained. The walls are hidden effectually from the besieger, and bomb-proof accommodation is afforded in the most economical manner. Instead of having an escarp and counterscarp to resist an assault, a counterscarp only is employed; and that counterscarp may, when it is required to do so, be made at the same time to answer other purposes, of bomb-proof cover, covered communication, entrance to countermines, and flank defence.

Any attempt to construct separate works for buildings and for fortifications must, of course, entail extra expense; but the two are here combined in a form, at once simple, cheap (by comparison), safe from assault, and difficult to injure by distant fire. In this way, all the bomb-proof accommodation that is required, in the main works or in the advanced works, may be first obtained; and a line of bomb-proof barracks, suitably constructed, may then, by the addition of earthwork, be changed into a fortress of a most formidable description. In fact, the necessary buildings are simply placed, in proper form, behind the earthwork which is required for their protection, and behind the counterscarp which is wanted for their defence.

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But there are other advantages attaching to such works. If, after much expenditure of ammunition, the besiegers succeed in destroying a portion of the ramparts, the remainder are still defensible. They are naturally divided (by their construction, in longitudinal arches) into defensible parts, analogous to the water-tight compartments of an iron vessel. By the use of musket-proof doors, to close the communication between them, they may be defended step by step. And, even if the enemy obtain possession of them, they are useless to him, because, while presenting a flat glacis of earth towards the front, their masonry is exposed to the rear, and they may be destroyed in a short time by the fire of works behind them.

The ramparts being thus formed in the cheapest and most durable form, and the flat slopes of earth only, which are but little liable to damage, being exposed to artillery fire, we have next to consider how the parapets can be best preserved from injury.

That a very large proportion of casemated fire will be required in future works cannot be doubted; and I have shown, in Plate II. fig. 15, a method in which I think these necessary casemates may be advantageously constructed. I have adopted the general principle of the casemate proposed by General Haxo, which was a brick arch covered with earth; but, where he left exposed masonry at the crown of the arch, I have added a thick iron plate, the better to secure it from destruction.

One of the great fortification problems of the present day, is, how such iron plates can best be applied to parapets, now that they have been found to be so powerful in resisting the effects of shot on the sides of vessels of war. Such plates, if placed vertically, and liable to be struck by shot at right-angles to the planes of their surfaces, cannot be expected, unless they are of considerable thickness, to resist repeated blows, delivered, perhaps, on nearly the same spot; and any iron construction of this nature that will do so, is exceedingly expensive; besides which, it would be impossible to repair a parapet of such material under fire, and difficult to replace it when damaged, by explosion or other means, within a limited time.

But, if 4-inch or 5-inch plates be placed in a slanting position, as shown in the figure, they will be less easy to strike, and very difficult to injure. Such plates ought to be bedded in timber, in order to secure them conveniently in their places, as well as (in this position) for the sake of elasticity, to prevent injury to the masonry below them when they are struck; and, in applying them, the size of the embrasure should be reduced as much as possible, though we cannot suppose that that will altogether prevent the enemy's shot from entering it.

The covering mass of earth on the top of the casemate affords an open parapet, which may be used for the service of infantry when required, and for that of light artillery when there is sufficient space.

Our fourth heading has reference to the principles by which we must be guided in determining the plans of future works of fortification.

The principle has been very plainly stated by Choumara, and has been partly acted upon in different countries, in the outworks and the advanced works of both the French and German systems, as I have already stated, that the besieger ought to be delayed by a series of obstacles successively opposed to him. If the besieger is able to undertake at the same time the operations required for breaching the revetment walls, and passing

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the ditches of several works, or of several parts of a fortress, then the time occupied in such operations is no longer than if he were compelled to ruin only one wall, and to cross only one ditch; but if, on the other hand, he is unable to carry on more than one of these operations at one time, and is obliged to undertake them one after another, then the time occupied by him is increased in proportion to the number of works opposed to him. If he were compelled to carry on a regular attack against two detached forts, one after another, he would thus, if these were well constructed and properly supported, be detained before them, other things being equal, twice as long as before a continuous line of ramparts, or two detached forts in one line. A step-by-step defence, as it has been called, conducted in this manner, has such obvious advantages, that it is only necessary to state the nature of it, in order to show how desirable it will be to adopt it as much as we conveniently can, and as far as it may be required in particular cases.

In applying this principle, in conjunction with the profiles which I have put forward, to the construction of a fortress, it would be desirable, in some cases, to employ a comparatively small (perhaps an existing) fortress as a citadel, or a continuous interior line of defence as a nucleus, and to surround these by advanced forts, constructed at various distances, in varying numbers, with different dimensions, and in different forms, according to the nature of the ground, the estimated number and character of the garrison, and the means available, or calculated upon, for the defence.

The forts shown in the diagram are simple barracks, of which the upper story is fitted for guns, covered with earth towards the country, according to the section in Plate II. fig. 15. In front of them, at the foot of the slope of earth which forms their rampart, are one or more counterscarps, connected with countermines. The besieger would be compelled to direct successive attacks against each counterscarp, and against each line of forts. He would be obliged to resort to mining before each countermined counterscarp; and, if he succeeded in reaching, and blowing in, the main counterscarp, he would still have great difficulty in getting possession of the works behind it, the approaches to which would be flanked by casemated caponiers of a most formidable description, in the manner indicated in the diagram. When the lines to be defended are not straight, as is most frequently the case, the flanking caponiers should be placed at their angles rather than in the centre of them, in order that a duplicate defence might be ensured to every part, not necessarily for simultaneous employment, but that, if one redoubt should be destroyed, the flank defence might be taken up by the flanks on each side of it, and might still remain perfect. The parapets and ramparts of these caponiers are somewhat similar to those of the other works; and they are provided with internal traverses to protect the gun-casemates from reverse fire, to form communications to the front, and to act as interior defences against sudden attacks.

The intervals between advanced forts would be advantageously occupied by rifle pits, or earthen batteries, to be thrown up or employed as required; those between forts composing a main line of defence, where such is employed, by continuous ramparts.

In the defence of long straight lines, or of other extended positions, the relative advantages of detached works, and of continuous lines, have been

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much discussed. I cannot here enter into all the arguments on either side of the question; but I would point out that the advantages of detached forts, and those of continuous lines, may be most conveniently combined by the method that I have described. A continuous counterscarp constructed in front of detached forts of this description, as shown in Plate IV. fig. 15, would be impassable to a besieger, unless after a regular siege. The detached works behind it would oblige the besieger to make his approaches on particular points which could be purposely prepared for his reception. Each would present, in itself, a maximum of offensive power and defensive resistance at a minimum of cost. This arrangement would have all the advantage of detached forts; in presenting points of security along the line occupied, and a means of safety for the remainder of that line after one point of it was forced; in being much more economical than continuous ramparts with escarps and counterscarps; and in capability of defence by a small garrison: it would also possess the advantages of a continuous line—in being better prepared for the reception of, and for giving useful employment to, increased forces; in affording perfect communication along the whole line, and in being secure at all points from any sudden irruption of the enemy under cover of darkness, for the purpose of passing the line, or for the attack of any intermediate works of a temporary character thrown up between the permanent forts.

Under a fifth heading, I have stated that the flanking defences must not be exposed to destruction by distant artillery placed on the prolongations of the ditches. I may add, that they should not be open to enfilade, or to interference in any way, from the enemy's fire.

I have already said a few words in reference to this subject, as applied to some existing works and systems. In the bastion system, as we have seen, either the flanks are liable to be fired at on the prolongations of the ditches when they are unprotected by the tenaille, or else they are masked by the tenaille, and prevented from defending the ditch by casemated fire. The parapets of the flanks are ruined by the enemy's artillery before they are required for use; and the tenaille itself is liable to be ruined in the same manner as the flank.

In the German fortresses, also, you will remember, that the caponiers, on which alone the main ditch depends for defence, though strongly and expensively constructed, are similarly exposed to injury in all cases in which the prolongations of the ditches can be taken up; and that the same may be said of the flanking defences of the smaller works.

These defects may be partly remedied by the employment of flanks firing inwards, instead of those firing outwards towards the country. In most advanced works, and in all works having salients projecting towards the country, a flanking fire from the counterscarp, or from a bastionet, or caponier, at the salient angle, would obviate the objection. The Germans have adopted this measure in some cases, and it has also been adopted in some of the forts in course of construction in this country, as I shall presently explain. To illustrate further what I mean by an inward, as opposed to an outward, flank defence, I would refer to a bastioned front. If this were reversed, or turned inside out, as has been done in the case of the main counterscarps at fig. 15 of Plate IV.—if, in fact, the bastion form of escarp were thus adopted for a counterscarp, then the flanks would direct

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their fire inwards in place of outwards; and it is probable that this reversal of the bastion trace may be found hereafter to be exceedingly useful. A flanking fire of musketry and artillery, in the nature of a reverse fire, from a hollow counterscarp, will be a very desirable means to adopt, in future, as a protection against assault; and it is probable that it will be much employed, as being economical, and secure from interruption from the besieger's weapons.

Such a means of flank defence cannot always be entirely depended upon, when the chance of a prolonged siege has to be provided against, because, as the besieger approaches the place in the course of his operations, he arrives, at length, by means of his mines at the back of the counterscarp, and blows it in; and, when this is done, an independent flanking fire, connected with the body of the place, is needed to check his further operations. To supply such an independent fire, and to give support between one work and another, I propose to employ the casemated caponiers, or redoubts, already referred to, which should expose nothing but earth and iron to the besieger's fire in all cases in which they would be liable to be cannonaded. Flanking works of this description are shown in plan and profile in the diagrams. They could hardly be destroyed, except by the besieger's mines, after the blowing in of the counterscarp; and this would, if properly opposed, be a tedious and difficult operation. They would afford mutual protection to each other in an efficient manner, and they would prevent all approach up the glacis-rampart, as it may be termed, until their destruction was effected.

My last heading refers to the question of communications.

I have observed that the use of long-range weapons will lead to the occupation of extended areas, and that detached forts in advanced positions, which have been already extensively employed, by the French as well as the Germans, in connection with recent fortresses, and which are coming into use also in this country, have now become still more necessary,—to save expense, to delay the progress of the besiegers, and to make small garrisons available against large numbers. But good means of communication are all-important to any system of defence by detached works. The more these detached forts are treated as isolated works, to be occupied and defended by a limited garrison, the weaker they become; and the more the resources of the place can be concentrated at the proper time, for the support of any advanced fort or forts forming the immediate object of attack, the stronger is the whole system of defence. The French have considered their detached forts more in the light of isolated forts; they have prepared them more with reference to their separate defence; and they have made them, if not equally strong, yet more complete on all sides. The Germans, with all their mistakes of construction, have looked upon these works in a different and apparently in a more proper light. They have been more careful in providing for their support by the fire of other works, and in contriving that the different works of a position should mutually contribute to the general defence; and they have attempted to render their detached forts sufficiently secure at the gorge, at the same time that they may be more or less easily destroyed after capture. They have also attended more than the French, in some cases, to the supply of underground, or other suitable communications. But much more will have

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to be effected in this way in future, in order that troops and stores may be advanced or withdrawn as required, to and from the different works, in security, and unknown to the enemy.

The so-called covered way by which systems of fortification have generally been surrounded, might more properly be termed an uncovered way, from its exposure to vertical and enfilade fire. From the latter, its irregular form and numerous traverses afford only partial relief; and it has, in fact, in consequence of its acknowledged defects, been in many cases discontinued altogether.

To fulfil the intended functions of such a work—of affording a musketry fire to the front, of supplying a covered communication round the outside of the main works on the further side of the ditch, and of providing the besieged with a secure retreat from the front, for sharpshooters, for troops returning from a sortie, or for detachments in advanced positions,—other means will now be required. For musketry fire, chains of rifle pits, in suitable positions, will be found in most cases more suitable than a continuous parapet. For the other purposes referred to, a really covered way might be employed, consisting simply of an arched gallery in masonry, covered with earth towards the front, and open towards the rear. It might be used according to circumstances, with parapets, or rifle pits, above it, or in front of it, or behind it. It would be useful, not only for purposes of communication round the exterior of any particular works, but also as a sort of connecting counterscarp and covered communication between detached works. Its dimensions would of course be regulated by circumstances, and it might vary from 10 to 30 feet in height. The besieger could not destroy it; he could not pass it; and he might be harassed by riflemen, possessed of a secure retreat to it, in a manner that would be most advantageous to the defence. It would afford a good point of commencement for any countermines to be employed for delaying the progress of the besieger toward the advanced works in its rear, and, when connected with such countermines, it could only be approached by the besieger by the slow process of mining, commenced at a greater or less distance in front of it, according to the extent or the reputed disposition of the countermines. Such a work would, in fact, become the front counterscarp shown in fig. 15, Plates II. IV.

Any attempt at a *coup-de-main* upon works such as I have been describing, would be utterly hopeless if the defenders were at their posts. It will be readily seen, by referring to one of the detached forts behind the main counterscarp at Pl. IV. fig. 15, and comparing it with the profile in fig. 15 of Pl. II., that if the besiegers did succeed in descending the main counterscarp, and getting into what may be called the ditch, they would then be exposed, to the full fire of the ramparts in their front, to that of the flanks of the counterscarp in their rear, and to that of the casemated flanking works on both sides of them. Situated between these fires they would be equally unable, to ascend the sloping rampart, to penetrate into the counterscarp wall, or to make their retreat; and they would be helplessly shot down, or forced to surrender. They would also be unable to advance, except by mining, after having blown in a portion of the counterscarp, until they had got possession of the flanks of that work, and had silenced the fire of the casemated flanks on both sides of them, and that of

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the faces in front of them. If they succeeded in descending the interior counterscarp, and in afterwards mounting to the top of the rampart, they would then be under the fire of the flanking works of the forts on either side of them, and also of the keep of the work itself, and they would arrive at another high wall, down which they would have next to descend, without any prospect of shelter at the bottom of it; or, if they were to make their way round to the rear, they would there find the rear counterscarp and the interior wall of the keep opposed to them.

We have now more than arrived at the end of our time; but I would say one or two words by way of summary before we part. I have purposely omitted details as far as I could, in order that we might take a comprehensive view of the question; and I will now endeavour to generalise still further.

For more than 5000 years, as we have seen, in the history of our race, there was no great difficulty about fortification. It was only necessary to build a wall of sufficient height and strength, and to excavate a ditch in front of it, to keep the besiegers' battering-rams away from it for as long a time as possible, in order to place a garrison in a tolerably secure position.

This state of things endured until gunpowder came into use. Since that time there has been, for the last 400 years, a continual hide-and-seek struggle between the attack and the defence; the engineer of the defence endeavouring to hide his walls, and to shelter their defenders from the artillery of the attack; the engineer of the attack taking advantage of every portion of ground less well defended than the remainder, for advancing his works, of every opening or opportunity for destroying his enemy's escarp walls, and of every unsheltered portion of the works for the operation of that description of fire best adapted for harassing the troops and the artillery of the defence. Up to the present time the protecting wall has contrived, through all its difficulties, to keep its face towards the enemy's fire, either in the shape of a revetment, or a detached wall; but it has always suffered more or less in the attempt, notwithstanding the ingenuity that has been displayed for its concealment and protection, and its destruction has only been a work of hours, when once the assailants have been able to open their batteries against it, or to approach it with their mines.

A new era in fortification is now dawning upon us; and I submit to you, that this protecting wall must not be ashamed to turn its back upon the improved weapons with which it is liable in future to be assailed, in order that it may become, at once more formidable to its assailants and more useful to its defenders. By forming part of a system of bomb-proof accommodation, and by hiding itself behind ramparts and glacis, it will be indestructible by artillery; and, being connected with a system of countermines, it will be protected for a lengthened period from the enemy's mines. The besieger will thus be prevented, at comparatively moderate cost, from successfully employing the very powerful means of distant destruction which he has acquired; he will be effectually checked in his advance; and he will be reduced, in his attack, to the slowest rate of progress that can be imposed upon him.

The operations before Sebastopol, which are still so vividly before our minds, have been sent to us as a sort of first lesson of what we are to

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expect from the use of superior weapons. The Russian riflemen were there most effective, and prevented the allied troops from showing themselves out of their trenches at the later periods of the attack. Artillery was employed from great distances, and, though not with anything like the accuracy that may in future be expected from it, yet with very destructive effects. The daily losses on both sides were enormous. In consequence of the difficulties of the soil, and the position and resources of the enemy, the English trenches never advanced to within 200 yards of the Russian works; and British troops never succeeded in an assault upon those works, in spite of their very inferior construction. The French experienced by far the greater part of their losses, and all their difficulties, in the course of their gradual advance. The Russians opposed that gradual advance, by holding with great obstinacy all the ground that they could possibly retain in front of their naturally strong, though weakly fortified, position,—by seizing all the advantageous sites of that position,—by employing all the men they could muster, and all the resources they could collect, to check the formation of the besieger's trenches. They suffered so very severely themselves, because they had not the advantage of a properly prepared enceinte, with bomb-proof cover, or well-constructed advanced works, with good shelter. Their troops were thus exposed to fearful destruction from the allied fire, and were unable to be maintained in sufficient numbers at points where they were most required. They finally lost the key of their position, because it had not been made secure against a *coup-de-main*, and because it had not been furnished with the amount of bomb-proof cover that was requisite to enable them to retain a sufficient garrison in it under the heat of the allied fire.

They also harassed the allies by means of sorties, and compelled them to be perpetually prepared to meet those sorties with troops that had almost more of labour and watching to undergo than nature could endure.

It has often been urged, that these proceedings cannot be taken as a guide to the ordinary operations of attack and defence, because the Russians possessed more extensive means, in men, munitions, and materials, than would be at the disposal of the commander of a regular fortress; and because they had the unusual advantage of free communication with the exterior. It is quite true that they were thus enabled to withdraw their worn out troops, and their sick and wounded, and to supply fresh ones in their places, as well as to procure supplies of stores and munitions; and that they obtained most important advantages in these respects. But even these facilities did not compensate to them for the imperfect condition of the works on which they had principally to base their operations. Their reinforcements of men were only brought, after great fatigue, after terrible privations, and after long marches, over desolate regions, for the most part to be miserably sacrificed to a want of proper accommodation. Such stores and munitions as they could thus add to their stock could not be employed by any means to the best advantage; and it is certain that, if they had been provided with suitable permanent works, they would, with far less advantage of communication with the exterior, have been able to prevent the allied forces from obtaining possession of the key of their position for a much longer period.

From this point of view, I look upon those operations as affording lessons

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of a most important character. They seem, in fact, to be a link, connecting the operations of the past with those of the future. They mark the commencement of a new transition style, so to speak, in defence. They indicate to us, once more, the disadvantages of former systems of fortification, in which small garrisons have been confined in limited areas with inferior means of shelter, and wretched opportunities, to what they might have had, for obstinate defence. They add force to the old French proverb, *petite place, mauvaise place.* They point to the advantages that may be acquired from the use of new weapons in enlarged systems of fortification, and to the impossibility, under ordinary circumstances, of successful defensive operations in future, unless such enlarged systems of fortification be adopted.

I shall not attempt now to apply the principles which I have advocated to the immediate question of our own defensive works; but I may observe, that there are two very important points, amongst many others, which ought to receive attention, in order that economy and efficiency may be duly combined in their construction. In the first place, not only the ramparts, but also the barracks, and other buildings of an extensive nature which may be required in future for military purposes in this country, should be constructed with reference to a well-considered general system of defence, though it may often not be possible, of course, to make them directly to contribute to that system of defence.

In the second place, advantages of position become the more important, now that musketry fire is effective for upwards of half a mile, and now that artillery have acquired the power of ranging for five miles, and of striking a target 6 feet square at a distance of two miles. There are cases, however, not unfrequently, in which the occupation of disadvantageous sites is unavoidable; and it becomes then necessary to apply with the greater circumspection the best remedies that the site affords.

I may also point out very briefly the leading principles on which fortifications are being designed for the defence of this country. Besides the works, intended to protect our dockyards and arsenals from an attack by sea, which are to consist principally of sea forts and land batteries, with the occasional assistance of floating batteries and booms, it is proposed to surround these vital points by detached forts, such as are shown in Pl. IV. fig. 14, to secure them against bombardment, up to a distance of 8,000 yards, wherever, not being screened by rising ground, they are exposed at that distance to such a mode of attack.

The detached forts are to be placed at central distances of a mile, or less, from each other, according to the nature of the ground to be occupied, with reference mainly to the commands of the sites which it presents for these forts, and to their capabilities in sweeping with their fire the spaces between them. Their faces, not supplied with casemates in the first instance, will, of course, be so laid out as to give the best direction to the guns on the ramparts. Their flanks are to be provided with gun casemates, and are to be employed, not for defending the ditches, (excepting when they may be available for raking any connecting lines between the forts which may hereafter be constructed), but for affording a cross fire upon the intermediate spaces, and for purposes of mutual defence and support between one fort and another. Their ditches are to be defended

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Fig. 2. Fig. 1.
Profiles of Ancient Fortifications.

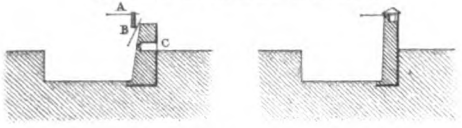


Fig. 3.
Profile of the Circular System of Albert Dürer, A.D. 1527.

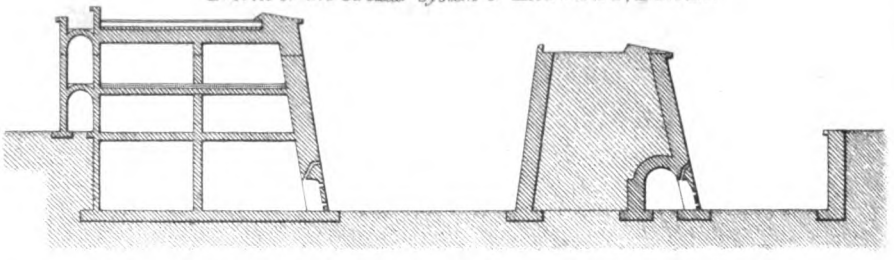
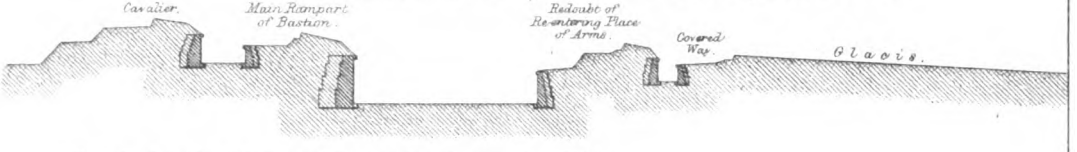


Fig. 4.
Profile at Berwick upon Tweed.
Section on A.B. Fig. 2 Pl. 3. close of the 16th Cent.

Fig. 5. *Profile of Modern System, Section on A.B. Fig. 7. Pl. 3. A.D. 1764.*



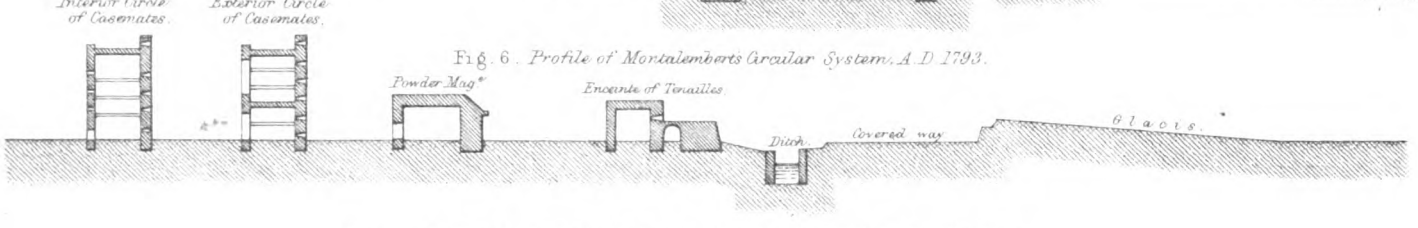


Fig. 6. *Profile of Montalemberts Circular System, A.D. 1793.*

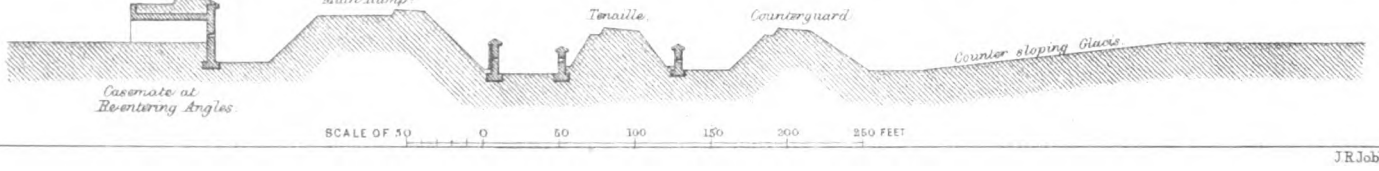


Fig. 7. *Profiles proposed by Carnot, A.D. 1810. for his Third or Tenaille System.*

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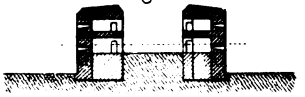
Fig. 8. *Profile of Fort Alexander, Coblentz. Section on A B. Fig. 9. Pl. 3. 19th Cent.*

Fig. 9.



Section on C.D. Fig. 9. Pl. 3. of Central Caponier at Fort Alexander, Coblentz.

Fig. 11.

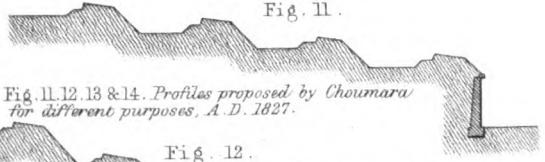


Fig. 11. 12. 13 & 14. *Profiles proposed by Choumara for different purposes, A.D. 1827.*

Fig. 12.

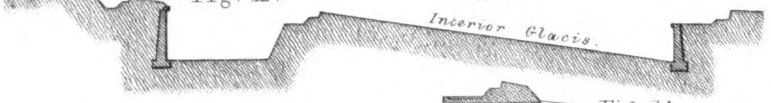


Fig. 13.

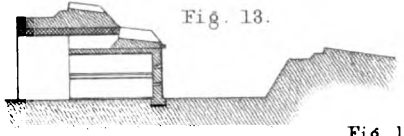
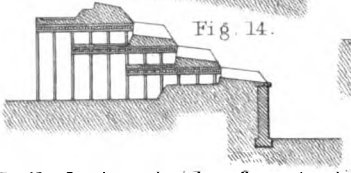


Fig. 14.



Thick Iron Plate.

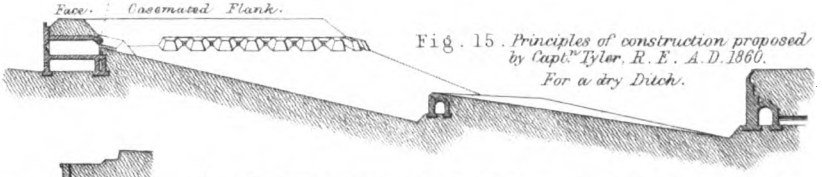


Fig. 15. *Principles of construction proposed by Capt.n Tyler, R.E. A.D. 1860. For a dry Ditch.*

Fig. 10. *Profile of one of the detached Forts at Cologne. Section on A.B, Fig. 12. Pl. 4. 19th Cent.*

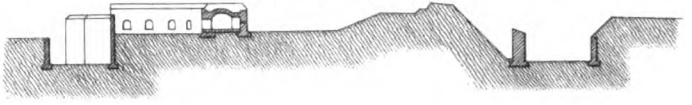


Fig. 16. *Profile shewing principles of construction on which detached Forts have been designed for Great Britain. A.D. 1860.*

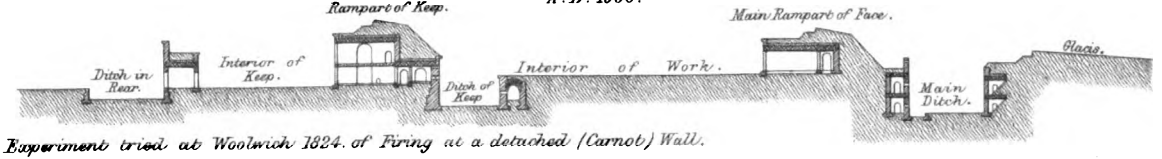
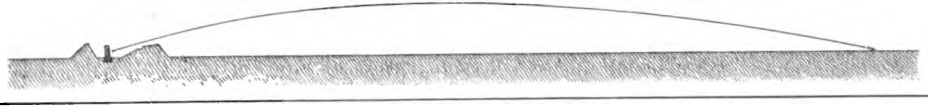


Fig. 17. *Experiment tried at Woolwich 1824. of Firing at a detached (Carnot) Wall.*



Scale.

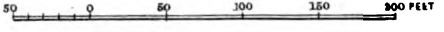


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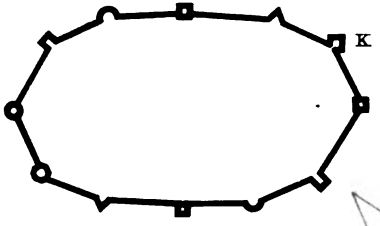
Fig. 1.

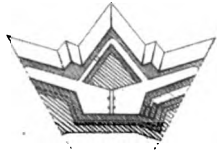


Plan of Ancient Fortification, with Towers of various forms.

Fig. 2.

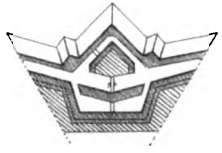
At Berwick, upon Tweed, Italian System, close of 16th Cent.

Fig. 3.



Pagan's System, A.D. 1645.

Fig. 4.



1st System of Vauban, A.D. 1680. adapted for a wet Ditch.

Fig. 5.

3rd System of Vauban, A.D. 1698.

Fig. 6.

Coehorns 3rd System, A.D. 1741.

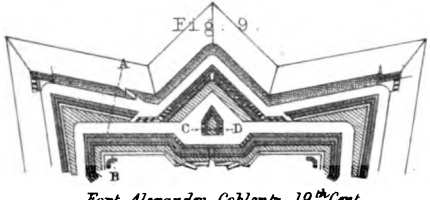
Fig. 7.

Modern System, latter part of 18th Cent.

Fig. 8.

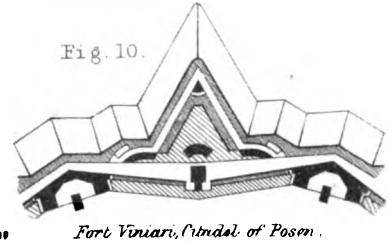
Bousmard's System, A.D. 1799.

Fig. 9.



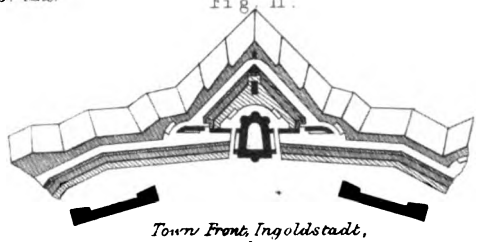
Fort Alexander, Coblentz, 19th Cent.

Fig. 10.



Fort Viviari, Citadel of Posen, 19th Cent.

Fig. 11.



Town Front, Ingoldstadt, 19th Cent.

Scale

100 50 0 100 200 300 400 500 600 700 800 YDS

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Fig. 14. *Plan illustrating principles of detached Forts, intended to be constructed in Great Britain.*

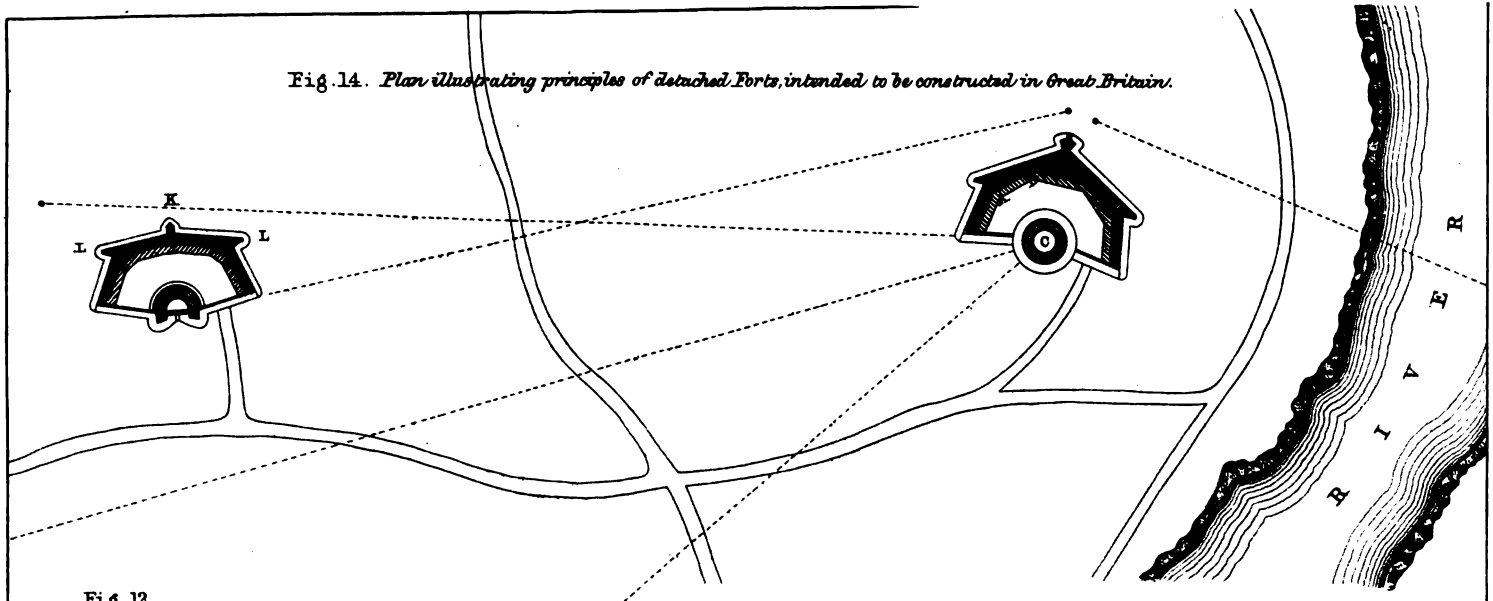

Fig. 12.
Detached Fort, Cologne, Present Cont.

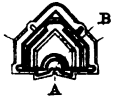

Fig. 13.
German detached Fort.

Fig. 15. *Plan shewing principles of construction, for detached Forts, by Capt.n Tyler, R.E.*

SCALE OF 100 50 0 100 200 300 400 500 600 700 800 YDS.

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by caponiers, one (K, in the figure) at the salient angle, firing right and left along those in front, and two (L, L, in the figure) at the extremities of the faces, firing inwards along those of the flanks. These latter, forming wings, as it were, to the works, are new in principle, and have the merit of being secure from the enemy's missiles, by firing towards the interior of the position. A keep is constructed in the rear of each work, to enable it to be held in security by a small number of men, and to be safe in the event of the exterior work being itself penetrated by the enemy by a *coup-de-main*. The circular keep C, shown on the right of the figure, is flanked by small masonry caponiers constructed round its circumference, and is not in the most favourable form in one respect,—that a great number of flanks (as many as sixteen) require to be manned for its complete defence, with a very limited range for the weapons employed in them.

Looking to the (specimen) profile of those works in figure 16, Pl. II., it will be observed, that bomb-proof buildings are to be constructed under the ramparts of the keeps, as well as under the main ramparts, and that the ditches in front of both are revetted in masonry, the escarps in each case being kept low, that they may be shielded from the effects of distant fire, and the escarp of the main ditch being surmounted by a parapet, to protect the *chemin-des-rondes*, from which a musketry fire may be directed upon the covered way in front. This small parapet affords additional height to the escarp as long as it is intact, but is liable to be destroyed from a distance by the guns of the enemy; and the besiegers, arriving at this point, would find shelter on the *chemin-des-rondes* from the direct fire of the work itself, and could only be annoyed, either by missiles projected over its ramparts, or by the fire of neighbouring works. The keep is defended in the rear by a wall considerably lower than the rampart in its front, and connected, like that rampart, with bomb-proof buildings.

Rifled artillery is not yet old enough to have produced a perceptible influence upon actual constructions in fortification in any country; but we are fortunate in this country in one respect,—that we are aware of these important improvements in musketry and artillery, whilst a large proportion of the works necessary for our defence are still unconstructed. British weapons are at the present time superior to those of any other nation, and I trust that British fortifications will prove to be equally pre-eminent in adaptation to the particular objects for which they are required. If I should be the means of contributing in any degree, however small, towards such a result, by exciting additional attention to, or by inducing discussion on, the subject, then I shall not regret having given you the trouble of listening to so much that possesses more, I fear, of technical, than of popular, interest.

N.B. The accompanying plates, referred to in the above lecture, are intended to form, of themselves, a brief sketch of the history of fortification, and to illustrate, as far as the space permits, the different ideas that have been put forward in that branch of science from time to time. The plans and profiles have all been reduced, respectively, to the same scale; and have thus been made to afford, at a glance, a means of comparison, with regard to their relative dimensions.

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Wednesday, May 30th, 1860.

Captain E. G. FISHBOURNE, R.N., C.B., in the Chair.

AN IMPROVED SYSTEM OF SHIP-BUILDING, AND ITS GENERAL ADVANTAGES IN POINT OF STRENGTH, CAPACITY, AND SPEED.

By George R. Tovell.

Stimulated by the recent statements publicly put forth by the new Society of Naval Architecture, and at the request of several members of the Royal United Service Institution, I am led to embrace the opportunity, now so kindly afforded me, to contribute my mite of practical experience to the accumulating fund of information, which will doubtless be found ample to effect the object which at this time is more particularly engaging the attention of all maritime nations; viz., the perfecting, so far as human ingenuity can perfect, that which is a staple of our own country,—the ship and her equipments.

But, Mr. Chairman, before venturing to do so in the presence of so much practical knowledge of the subject (which I trust I know how to appreciate), blended, as it is, with intelligence of the highest order, I do most respectfully ask from you, Sir, and from this assembly of gentlemen, all the indulgence you can award to an old man, who for the first time in his life ventures to speak before a public assembly.

As I am a perfect stranger to most of the gentlemen composing this meeting, whom, with yourself, I have now the honour of addressing, will you, sir, be pleased to permit me, for general information, to state that I have been intimately connected with ships, and what relates to them, for at least forty years, during which time I have had an opportunity of gaining some little experience, as a shipmaster, shipowner, and ship-insurer or underwriter. Possessing, naturally, I suppose, a disposition to try and improve the form of ships, I have been led to alter materially many of the old build, and to design some new ones, long before I thought of reducing my practice to the system which I am about to bring to your notice.

I have been a close observer of the qualities of different ships in a seaway, when under sail, and at anchor, which no doubt has enabled me to effect some advantages in designing, rigging, and sailing my own ships, and which has led me often to disregard adverse opinions.

I am led, sir, to make these preliminary remarks, from reading some, of rather a sweeping character, made by one of the speakers at the recent meeting of naval architects, as to the very little good, in his estimation, that had arisen from patented improvements in shipbuilding, assigning as the cause the ignorance of most of the patentees; now it is not impossible

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that, with equal applicability, this might be said of some of the objectors. But whilst I do hope to be free, if not from the full force, yet in some measure from this censure on patentees, I wish it to be clearly understood that I make no pretensions to the purely scientific attainments which most likely fell to the lot of that speaker; yet I do not believe I should be, in the formation of ships, much a gainer by exchanging my practical knowledge, small though it may be, for his scientific attainments, for it must be admitted that abundant opportunity has been afforded to scientific gentlemen to produce ships, yet very many of their productions are now found not to answer the purposes for which they were designed.

Simply aided by a little practical knowledge of what the sea likes, if I may be allowed the expression, and an average share of common sense, I have ventured to place ships, of the form I am now about to advocate, upon her bosom.

And now to my task. First, then, what I have aimed at is simply this: to get a strong, well-conditioned, seaworthy ship, possessing capacity enough for cargo to remunerate her owners, and speed sufficient successfully to compete with the navies of other nations; and I may also add, to escape an enemy, even should that be a deadly lee-shore.

Knowing well, Sir, that speed without capacity could not be generally useful, and that these combined, without strength, were worse than useless, I set myself to devise a form in which all three should be found in the largest degree compatible with the other essential qualities of a well-conditioned ship.

After no inconsiderable thought given to the matter, I was led to the adoption of the circle (or rather segments of it), seeing that it possessed two of the three things I was seeking for, viz., strength and capacity.

My next business was to determine how they could be brought into the general construction, so as to secure speed with free or adverse winds, good steering, and other qualities.

To help me in my decision in this, I sought for that in nature which would guide me, as so to arrange circular frames as to get speed with space. To this end I examined fish, and was led to say to myself, "they can pass swiftly through the water, but they have not capacity sufficient for my purpose—no room abaft; nor could vessels of their form carry sail."

I then turned my attention to the water-fowl, and in them discerned capacity and power, but no speed like the fish, which was what I wished, if possible, to attain.

Now from my youth up I have believed, that the Great Designer was the only unerring architect; and was on that account unwilling to seek instruction in any other school—so I at last determined to avail myself of the salmon's head and shoulders for the fore-body, and the after-body of the swan for that of my intended ship, believing that, by their judicious combination, I should get capacity, power, and speed, with wind free; at once foreseeing that, with such a form, weathering and excellent steering qualities were placed within my reach, by the adjustment of dead-wood and keel. Here I cannot refrain from availing myself of a very trite observation of Mr. Scott Russell's, "that a good ship should have the easiest form to go a-head, and the most difficult to get to leeward." I hope I shall be enabled to convince this meeting that I have succeeded in obtain-

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ing these desirable qualities, in no small degree, by a process as simple as it is truthful, and which I now proceed to explain.

The length of the deck, depth of hold, length of keel, being decided on (having regard to the particular service the vessel is intended for), the line A, B (fig. 1) is to be drawn to a given scale; this represents the deck line. Having added to the depth of the hold the thickness of the floor timbers, inside plankings, and keel, at this distance from and parallel to the line A, B, draw the line C, D, to represent the lower line of the keel, upon which set off the length of the keel, making allowance for the intended rake of the stem and stern-post. Then draw the lines H, E, forward, and F, G, aft; these represent the outlines of the stem and stern-post. On these lines mark the points H, I, for the fore and after ends of the load water-line, and at the place of greatest breadth (which may be at any distance from the stem) mark a point K, showing the upper part of the keel; then with the proper radius draw an arc, cutting the three points H, K, I. This is to form the top of a solid frame-work connecting the stem and stern-post by curved dead wood, upon which the frames forming the hull or body of the ship are to be placed. From the point H, a line is now to be drawn to a point L; by this line the curves of the timbers at different points are regulated. The particular angle or curve to which this line is drawn is entirely arbitrary, and dependent on the judgment of the designer of the intended vessel's form, and the particular service she is required for, as we shall show after describing its use. If it be required to know the form of the timber or frame of the ship at the point K, draw a perpendicular line from thence to the line H, L; with the radius M, K, draw the arc N, K, O, carrying it up to the deck line, which will be the outside form of the timber or frame of the ship at the point K; and this operation is to be repeated to determine the form of every rib throughout the vessel's length, in all cases taking the radii from the line H, L, to the curve formed from the points of the load water-line H, I. It will be observed, that in proportion as the line H, L, rises above or falls below the deck line at any part of the hull the circles are of greater or less diameter, and consequently the after part is broad as compared with the fore body, where the line H, L, dips considerably below the deck line. For this part of the hull, where the bow draws in and becomes fine, the semi-circles formed by radii obtained as before described are too shallow to reach the sheer line, they must therefore be carried up by perpendicular lines to the line A, B.

From what has been stated with regard to the line H, L, and the method of regulating by it the entire form of the intended vessel, it will be evident that it is only necessary to vary the inclination or curve of this line to obtain vessels of any form or capacity that may be required. Thus, if it is desired that the ship should be fuller at the bows, the line H, L, must be carried upward, as shown by the dotted line *a*, *b*; if, on the contrary, a finer bow is wanted, the line H, L, is to be carried lower, as at *c*, *d*; the after part of the body or hull being made finer or fuller, as desired, by varying the line H, L, in the manner just described, still retaining the form of hull peculiar to this invention. Fig. 2 represents the half-breadth or deck plan of a vessel, where the breadth and depth of the vessel are alike, the semi-circles in fig. 1 giving the outline of the one-half of the deck of the intended vessel. Fig. 3 is the "sheer plan" or longitudinal

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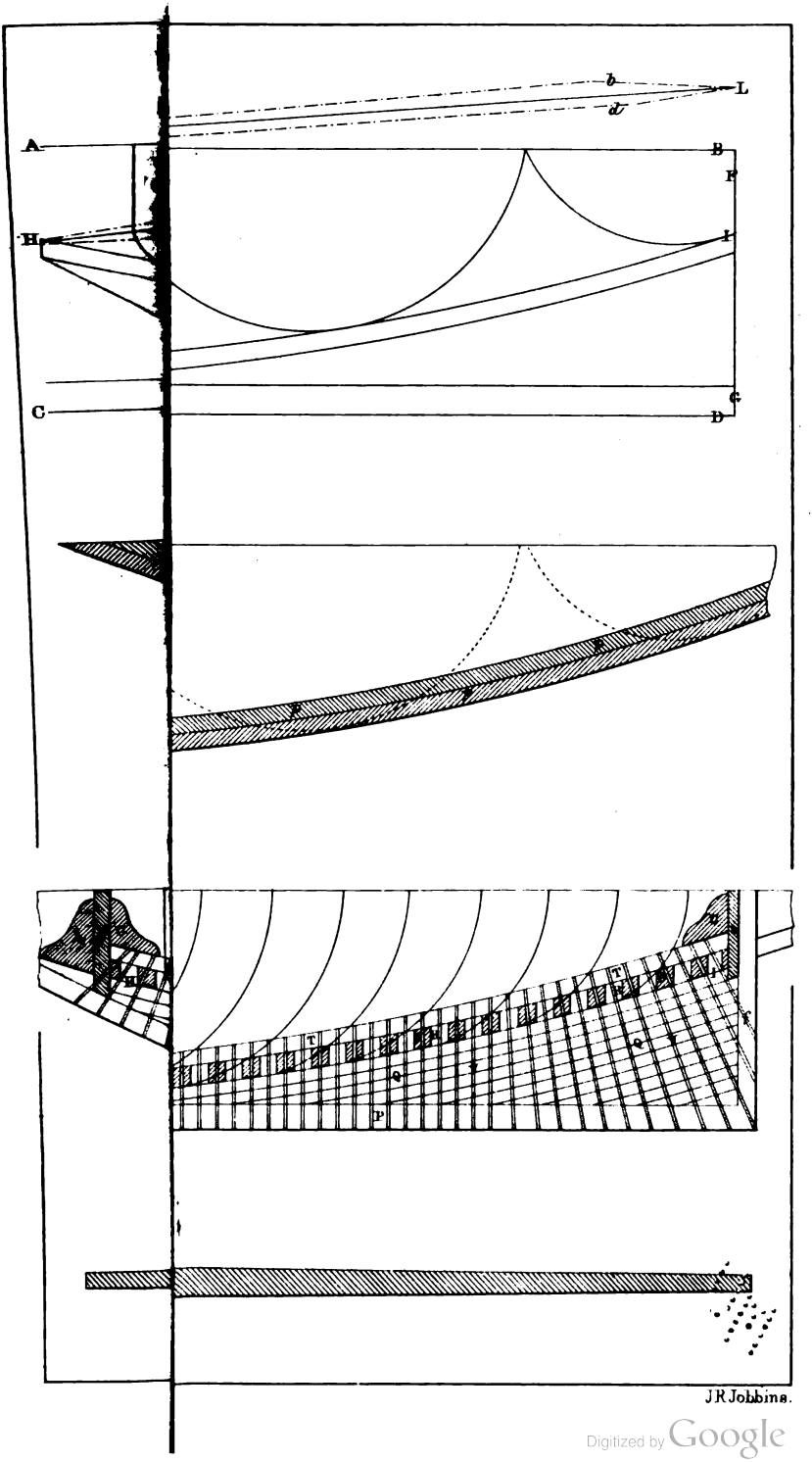

J.R.Jobbins.

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section of a vessel drawn to the same scale as fig. 2. P is the keel upon which the curved timbers Q, Q, Q, are built, forming the arc H, K, I, (fig. 1.) The stem and stern-post *e*, *f*, being secured to the timbers Q, Q, Q, the frames R, R, of the hull are then set up; between each frame a solid chock S, S, is fitted, connecting or supporting each and all the frames from stem to stern. Over these frames, thus firmly chocked, the kelson T is wrought, terminating with a strong wood knee U, U, fore and aft. The whole of these timbers are firmly secured together by bolts V, V, passing through them, and secured to the under side of the keel, uniting also the stem and stern-post, and rendering the frame-work and lower part of the ship one solid mass of timber. The tendency which a ship of the ordinary construction has for "hogging" or arching in the centre shows itself from the moment of launching, and this is increased to a very injurious extent when the vessel is pitching in a troubled sea: the wave as it rolls under the vessel lifting it in the centre, while the ends are comparatively without support; this has the effect of straining and loosening every part of the ship's framing. Now, the inverted arch form given to the dead-wood of the vessels herein described, and the manner in which the entire frame-work and keel are bound together, will obviate this evil, or at least tend to very considerably mitigate it. A short stem, *g*, is fitted upon the main stem, to which is secured the fore knee U; it also receives the fore end of the top planking, and gives additional strength to the fore body beyond the stem *g*, which is further secured to the main stem by a knee *h*; or the fore-part timber may be carried to form the head, or give any ornamental finish that may be desired. Additional strength and security are also given to the stern of the ship by filling in the hull inside the stern-post with a water-tight bulk-head *i*, of solid timber; beyond the stern-post the timbers and deck may be carried out to any extent desired to form an overhanging stern, as partly shown at *g*. Now, should this portion of the ship be carried away by collision or the force of the waves, the strong partition *i* will preserve the vessel from further damage by the ingress of water. To add to the strength of the upper part of the hull, on the inner side of the frames, and level with the deck, we attach strong double waterways *p*, *p*, of oak (fig. 2); these are carried round the vessel, and firmly bolted to the ribs and beams, and to these the bulwarks are secured, so that on the ship being struck the additional resistance of the double waterways are offered to the opposing force; and, the bulwark staunchions being within the outer frames, and through the oak waterways *p*, *p*, are not so liable to be carried away, as the bulwark is kept clear of the sea when the ship is under canvass. We give to the keel the form of a double arc, as shown at fig. 4, tapering it off at either end where the reduced weight is advantageous.

Having endeavoured, Sir, to show what I have aimed at, and how I have gone to work to obtain my object, it only now remains for me to explain with what results; and first as to strength:—

Reference to the diagram will show, that by the combination and position of the several portions of timber composing keel, stem, stern-post, dead-wood, and the actual crossing of floors with the curved kelson, when kneed up to the stem at one end of the ship, and the water-tight bulkhead and sternpost at the other, that an immense amount of strength must be

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obtained before a single plank is wrought, every one of which (in proportion to its substance) adds to it, as do also the butting of the timbers, for, being cut from a centre, like the felloes of a wheel, longer on the outside than on the inner part, you have but to keep them to their position, and they will bear any reasonable amount of pressure; instance the wheels of large timber-gins (which are not half the substance of half a single frame of a ship), jolting over uneven surfaces, sustaining sudden shocks with heavy loads, which their form alone enables them to bear. The planking also round the whole body, like an extra ring of bricks or stones to an arch, is adding to this strength, so that when all is properly wrought, fastened, and caulked, it is next to impossible to force the bottom or sides of ships so built out of their position. Then we gain another very important advantage by breaking the line of separation at the heads and heels of the frame timbers, which, if it be correct to argue that nothing is stronger than it is in its weakest part, ships of the usual build, so far as this separation affects them, can only be said to be half as strong as they appear to be. The shift of timber to which I am referring is consequent upon the formation of the bottom causing the heads and heels to rise one above another.

But, further, as a proof of strength, I beg to state, that I saw the "Margaret" (I think it was on the day before launching) resting, as this model now does, on a single support in mid-length, 50 feet of her fore-body being sustained by its own strength alone, without the least injury. I well remember the foreman's reply to my observation, that it was "rather a severe test." "Oh, that won't hurt her; you might hang another 'Margaret' to her bowsprit and she would bear it." This, Sir, shows longitudinal strength. In support of general strength, allow me to adduce the evidence of Mr. B. Beckwith, a man of integrity, well able to judge and form a correct opinion: he sailed in her for about twelve months, and writes to me, "It is with pleasure I forward to you my testimony as to the merits of the 'Margaret.' It is my firm conviction that she stands unrivalled in strength, speed, and stability. When under a pressure of canvas in a seaway she does not show those symptons of weakness (by the creaking noise) that is usual in most ships; on the contrary, she is almost as quiet as if lying in a dock. During the time I was in her, I never saw the least movement, either abreast her mast, waterways, or anywhere else."

But her strength (as if to afford evidence to suit my purposes) was subjected to another kind of test, perhaps the greatest that the combination of hull and dead-wood could be put to.

On her second voyage, being bound to London, loaded, and in charge of a pilot,—somewhere above the Nore he managed to get her upon one of the sands; it was on the first of the flood-tide, which, setting on to the sand (the vessel drawing eighteen inches more water aft than forward), necessarily carried her head-on. Instead of holding this vessel stern to the tide, until there was sufficient flow to swing and bring her head at it, he let go her bower-anchor underfoot, and veered away cable till it was almost all out; he then held on, and she canted a little, and moved a little, until she was held athwart the tide by her cable and anchor at one end, and her heel on the ground at the other, the whole force of the strength of the tide being on her broadside. She was laid in a proper place (after this was

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known) to examine her, when it was found that she had sustained no further damage than the anchor had occasioned, by ripping off a little of her copper.

I adduce, as another instance of strength, the fact that, the "Laughing Waters," when being towed from Antwerp in ballast, being caught by a sudden and severe gale of wind, the steamboat not possessing power sufficient to prevent it, took the ground on one of the shifting banks, which dried at low-water. When the flood made, the sand on one side of her began to scour away until (as the Captain told me) a hole was formed nine feet deep, into which she rolled, easy as a cask would have rolled into it: had this happened to a ship of usual build, is it too much for me to say, her floors, if not her back, would most likely have been broken? But this ship, when docked in London, was found none the worse for this severe trial.

I will, Sir, by your permission, read the opinion (on this point) given in writing by a shipbuilder of an eminent firm in the port of Hull, also that of another practical man well known in London, and in Her Majesty's service.

February, 1860.

I HAVE been on board the "Sisters," as you requested; from what I can see of her afloat, her form is calculated to impart *great strength*. I think she would scud before the most violent storm; but fancy her stem being so much under must be against her going to windward.

April 25th, 1860.

MY opinion as regards your mode of building is, that it is true as the Gospel—*nothing can equal it for strength*.

A SHIP'S CARPENTER IN THE SERVICE.

This, I hope, will be sufficient to prove that we have not failed to secure in vessels of this build, great strength.

Now, as to capacity with relation to the materials used, very little, I presume, need be said on this head; as—

The figure employed is that which affords the greatest capacity; but as some persons have doubted, and others have denied this, I adopted a simple and convincing illustration, by causing two pieces of metal to be cut, of like size and shape, one piece fashioned into a square, the other into a circular form, to be measured one against the other; I need not add with what result. Yet, in one instance, such is the effect of prejudice, I heard a person, after such trial, declare there was something wrong about it; he would not believe a circle to be as large as a square. I suppose it must have been something of this kind that gave birth to the proverb,

> He that's convinced against his will,
> Is of the same opinion still.

But to come a little nearer to actual practice, Will these vessels, said to be so fast, carry a remunerating cargo? Now, Sir,—as 100 cube feet is computed to be a ton register,—NM is 100 cube feet; vessels of like tonnage, if filled with anything that would run into every part, must be found to hold a like quantity, but, as this 100 cube feet is in vessels of divers form, if filled with goods that will not accommodate themselves to every form, it follows that those of most convenient shape must have the advantage; hence the very fine lines of the entrance and runs of many

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clipper-built ships are against them, and have led to a widely-spread opinion that but very little space can be had in combination with great speed. With such conclusion I am at issue, being borne out by facts patent to any who will take the trouble to investigate them. Allow me, Sir, to read you an account of cargo shipped on board a vessel of only 491 tons register, in the London Docks, and safely delivered from her at Hobart Town, with which cargo on board she exceeded 16 knots under sail.

London,
November 6th, 1858.

SIR,—Inclosed is the tonnage of the "Laughing Waters," Captain Lay, per Hobart Town, consisting of 104 tons weight, 16 tons liquids, 857 tons measurement, total 977 tons, in addition to which she had a deck load of timber for cranes, &c.

(Signed) RICHD. WEBB & Co.,
G. R. TOVELL, Esq. 32, Leadenhall Street.

Hear also the Captain's account of cargo and speed after his first voyage in another vessel (which is now in the London Docks loading general cargo for Mogador). This vessel, "The Sisters" of Portsmouth, is but 128 tons, and only 105 feet between the perpendiculars.

MR. TOVELL, Fresh Wharf, London,
November 6th, 1859.

SIR,—In haste I now write to inform you of our safe arrival, after a very boisterous passage, but I am happy to say our ship is a *wonderful sea-boat;* we have been able to sail with a gale of wind and average ten miles an hour, when other ships had to "lay-to."

We were very deep on our outward passage, having in 216 tons of patent fuel, and have brought home 180 tons gross weight, or about 127 of net fruit, which is coming out in excellent order.

We were out of trim coming home, being *a foot too much by the head;* this made her require her head-sail so long that we carried away our jib-boom, and were *seven days without one.*

The ship has given me every satisfaction; she is a powerful vessel and a wonderful bad-weather one; below, in a gale of wind you can scarcely feel her; she ships no heavy water, and *scuds beautifully*, and when in trim is as handy as a boat; she has little or no *pitching motion;* much as we were by the head we never put our bowsprit in, and you know it stands very low.

I intend putting a false keel on her, and I believe she will be the *fastest boat afloat*, to or off the wind. We have got as much as thirteen knots out of her, and I am quite confident she is able to go fifteen.

I must tell you what she did in the Channel; we came from *Dunnose to Beachey Head* in three hours and forty-five minutes, tide against us chief of the way.

A fine vessel was boarded off Dungenness *two hours and a half* BEFORE us; we were alongside her in four and a half.

I remain, dear Sir, yours truly,
Schooner "Sisters," J. T. STEEL.
of Portsmouth."

N.B.—This vessel is but 128 tons register; 105 feet long between perpendiculars.

The brokers, Messrs. Knell and Co., Pudding Lane, who did the business in London for this vessel, after she had delivered four cargoes, told me she put out the most for tonnage of any they had had this season.

These things go to prove that the form is good for stowage; and, what is another advantage with the merchants who have employed them, they stand first for charter, and sometimes at a little extra freight.

I come now to speak more particularly as to speed; and, that I may

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afford myself opportunity to put before you, Sir, and this assembly, some of my notions, which may not be found uninteresting, allow me to put, and to answer, a question, viz.: "Why should these vessels go faster than other clippers of like dimensions?" My reply is, That from the form of the forebody, from the load water-line to the keel, every foot of length is making, and only making, its due proportion of displacement for the free passage of the largest or midship-section. This I think cannot be said of any other form of entrance.

In the second place, the direction given to the passage of the water under the forepart of the vessel is found in practice actually to lift the ship; so that, instead of accumulating about the bows or around her, and forming an obstruction, it causes a decrease of the submerged area of every section from forward to dead-flat.

In the third place, I hold that, as soon as the ship is put in motion a-head, the preponderating weight of the after body over that of the fore, of the weight of cargo abaft dead-flat over that before it, with the addition caused by the lifting of the bow, all aid the onward progress of the ship.

In the fourth place we have not a foot of straight below the load water-line, which, in a sea-way, whether found in the bottom or sides of a ship, is necessarily a hindrance to speed.

And lastly, in addition to the reasons stated, is the fact, that with every ton weight put into these craft you gain an increase of length and breadth to carry it, still retaining an unaltered form for rapid passage through the water, so that, if canvas could be increased with cargo, these ships would always go faster loaded than they could when in ballast trim, as we find they do now in strong winds.

Being convinced that to these things we owe our great speed, I give them as an answer to the question, "Why should these vessels go faster than other clipper ships?"

On what other principle are we to account for a vessel only 100 feet long (indeed not that at the water-line), and 24 feet beam, reaching fifteen knots, and another, only 166 feet long, with 34 feet beam, exceeding sixteen knots as deeply-laden ships, rather (as merchantmen) under-rigged, and with no steam-power to help them; and, I pledge my word, Sir, that on the first day canvas was set upon the "Margaret," wind blowing fresh, with rain, being timed by a-stop-watch from beacon to buoy, she was found to have performed the distance at the rate of fifteen knots an hour under three sails.

The testimonials of many different persons go to show a like speed.

On one occasion, after giving the racing yachts a start of twenty minutes, with the wind and tide strong in their favour, and during the race giving way, so as not to interfere with their sailing, she came in a-head of the headmost yacht. I was on board her. We did not set our topsail till off Gravesend, and had but an ordinary crew to set canvas, and to *get*, not to *slip*, from our own anchor, which would not have been the case had she been racing.

The same day, being under the lee of the steamer "Petrel," that vessel being then at full speed, she hauled her wind, and luffed across her bows, walked out to windward, and passed her with ease.

The *Times* of 24th May, 1858, giving an account of a match sailed

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about that time, states, that the distance (from Erith to the Nore and back) was performed in 5 hours 39 minutes, and that it was the fastest on record.

I have a P.S. in a letter written by Captain Beckwith, to this effect: "In my previous note I should, perhaps, have stated that the 'Margaret' sailed the match course from Erith to the Nore and back in four hours and eighteen or twenty minutes, I forget which, but I question if that was ever done before or since in the time."

This gives our cargo vessel 1h. 19m. advantage. Again, according to the *Times* of the 15th February, 1854, the "Great Britain" arrived at Liverpool on that day, and reports "strong winds from E.N.E. since passing the Azores."

The "Margaret" left the day the "Great Britain" passed the Islands, and landed her letters at Hastings on the 14th, being the day before the steam-ship reached Liverpool.

The owners of the "Mignon" of Liverpool (one of their fastest fruiters), acknowledged to me that the "Margaret," for several successive days when off from the roads of St. Michael's, in consequence of strong weather, did sail round her, having her foresail to windward, or aback, and the present owners of this extraordinary little craft (the "Margaret") having stated, in the year 1855, that she had given them every satisfaction, having made her passage from Amberir, in 7° south, to Liverpool (a difficult passage to make) in 40 days,—seldom, if ever, before made in less than 60 days,—write again, in 1858:—"In reply to your inquiry, we have much pleasure in stating that the 'Margaret' continues to make her rapid passages as usual, and is everything we could wish;" their Captain clenching the whole by declaring "she is the fastest piece of wood ever put upon the water." Now, can anyone be surprised at the character I have given her in the following rude lines—

Whoe'er with this vessel shall once cross the seas,
I am sure with her actions can't fail to be pleased;
"Off the wind" like a phantom she flies from the rest,
But when brought "upon it" she proves herself best.
A lee-shore you fear not, whilst she carries a rag,
For over the billows she bounds like a stag.
She has power like a frigate; speed like a "well-bred;"
To her canvas she rucks not, and steers with a thread.

You can make allowances, Sir, for a father's description of his own child; but it is not to be forgotten that, if he will speak truth, no one can have a better knowledge of that child.

"Laughing Waters," per Log-Book, when loaded.

1858, March 13th, 8 hours, 15 knots; 4 do. 14; 4 do. 12: days run, 288.

1859, January	25th,	days run	. .	225
„	20th,	„	. .	233
„	27th,	„	. .	334
„	28th,	„	. .	243
„	29th,	„	. .	216
„	30th,	„	. .	200

The Captain writes, It is no unusual thing with us at eight o'clock in the morning to see a sail a-head as far as we can make her out, and to have

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her as far astern by four in the afternoon. The crew also assert that in the squalls she has made 16½ or 17 knots off the reel, and by patent log; that she steered like a boat, and, well handled, would do anything. The Captain says, "I can, now I am used to her, make her do anything but speak;" he also told me that a little boy, who was obliged to stand on the carpenter's caulking-box to enable him to see the compass, could run her under double-reefed sails.

I have nearly done with this part of my subject, having only a few words about the little "Silver Star," which I consider spoiled in order to comply with Club rules of admeasurement. She has too little beam to get all the advantages of the system. She sailed three matches; one at Walton-on-the-Naze, and two at Harwich. In the first she won a silver tankard, beating the second boat half-an-hour. At Harwich she took thirty sovereigns, competing with the "Oriel" of 25 tons, the "Eva" of 20 tons, she being 25 tons; the "Eva," a fine little craft, was second yacht in. This was no day for sailing, as you will suppose, when I tell you it took six hours to do twenty miles. This led to an arrangement between Mr. Hope, the owner of the "Eva," and the owner of the "Silver Star," for a trial over the same course on another day named, on which there was a fine sailing breeze, and a good deal of interest was excited: they started, and at the first station the "Silver Star" had gained five minutes; at the next, ten; and at the last, twenty; so that her superior sailing qualities were admitted, the advantage not being the effect of a favourable puff, as is often the case. The "Eva" was built by the justly-celebrated Wanhill of Poole, and considered a fast yacht.

Surely, Sir, it is worthy of note, that all these advantages, great strength, large capacity, and a few extra knots at the difficult end of the figures (for, whilst it requires but little effort to get 10 or 12, it becomes quite another problem to add materially to it), involve no extra cost, being solely the result of form, which is always telling, and sometimes, as is well known, is the sole cause of safety, as opposed to total loss: instance the case of two ships caught in a sudden gale of wind when close upon a lee-shore, one a moderate sailing vessel, the other from her formation very fast; the smallest storm-sails, we will suppose, are all that will hold together; it becomes an effort for life,—for it, with the safety of ship and cargo, hangs in the balance, depending entirely on the sailing qualities of the ship. Now, when we speak of value, who in all this assembly can estimate the difference in value between the whole combined qualities of the two, if one, by her ability to clear the coast is safe, whilst the other, failing to do so, becomes a wreck, and her brave fellows, who richly deserve more concern for their safety than is generally manifested, perish. I hesitate not to affirm that a very large proportion of ships that strew our coasts every year, are lost for want of sailing qualities. Coasters, of all other ships, should be fast, for they are always necessarily close to the land.

Again, in the calculation for everyday work, it should not be forgotten that two knots an hour speed possessed by one ship over another, in a passage of 70 days, gives 3,360 miles to the good, and that, to bring up this, an ordinary vessel, supposing her to maintain during the whole time 6 knots, would require 23 days, in which time the faster one would be 4,416 miles a-head of her. It is—I feel it to be so—almost impossible to

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calculate all the advantages of speed in ships; but look at the bulk of our ships in this respect,—from 3 to 6 knots on a wind, and from 7 to 8 or 9 free, are their rates. Why should this state of things remain? A ship is not like a house; if she is a bad-conditioned one, spend no money to prolong her existence; wear her out, and build a good one.

Sir, these are the elements, and some of the results, of a very simple and inexpensive system, which do indeed involve advantages too numerous to be touched upon in so short a lecture.

May I now call your attention, Sir, to the models on the table? This small model shows—I think it will be, as it has been, admitted—that elegance can be produced upon this system; it would make a very fast and comfortable yacht, and, when no longer required for that purpose, be a saleable property at the market-price of merchant ships, as she would at any time make a first-rate fruiter. I think, for many reasons, it is to be regretted that gentlemen do not determine that the entire outside measure shall be taken (as the inside is in merchant vessels) for ascertaining the tonnage; it would leave every designer free to use length, breadth, and depth, according to his judgment, which now has often to give way to Club rules, as was the case in the "Silver Star."

The sectional model on an inch scale, 155 long, 26½ beam, 15 deep, about 285 tons register N.M., 495 old or builder's measure, length of keel 127 feet, would make a very nice little West Indiaman, in which trade merchants prefer smaller ships than formerly.

The painted model is intended for a 1,160 ton ship.* Her dimensions: extreme length 200, breadth 33·4, depth 20, length of keel 171 feet (N.I.).

I now come to these models of men-of-war, and I really wish my partner, Mr. William Miller, R.N., who has produced them, and who, having spent some 25 or 26 years in the service, is necessarily better acquainted with what constitutes a good man-of-war than I can be, could have given his own description of them, for I fear that I shall not be able to do him justice; but I have this satisfaction, to know that the models are before those who, almost at a glance, can do so. I will therefore simply state, that this model has between 9 and 10,000 tons displacement; is designed to carry 52 of the heaviest guns on the main deck; to be cased with upwards of 2,000 tons of iron on her sides and decks, to resist as much as possible shell, and even solid shot; and to possess sufficient stability to carry all this enormous weight, together with 1,000 horse-power engines, coals, stores, and provisions for 700 men (fully considered and calculated), and to retain all the essential requisites of an efficient man-of-war, that would enable her to be superior to any one of the larger line-of-battle ships, especially in heavy weather. Mr. Miller has carefully, and with deep interest and solicitude, studied this subject, during and since the siege of Sebastopol. He thinks the improvement of our men-of-war to be more in appearance than in reality; that in bad weather they are not even so good as the ships of olden times; that they cannot keep the sea so long. He believes this system may be adapted to all classes of ships of war, and that they would in no way be inferior, not even in appearance; on the contrary, that to use the system in our naval yards would give us very superior ships in every respect.

* A vessel we purpose to build.

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while it would enable them to be constructed cheaper, quicker, and stronger than ships of the ordinary form.

You will observe that he has placed the screw further forward than is usual, as this can be effected without diminishing its diameter, and the advantage is, that the propeller is more out of the way of wreckage, &c.

He has also made provision for closing the screw-well (which method practical men think simple, strong, and effective) with slides working in a metal case, which are intended to be flush with the outside planking (not as seen in the model, which merely exemplifies its working). The slides have a rack fixed to their upper surface, which is acted upon by a bevel pinion wheel, worked by one man by means of a vertical shaft passing through a stuffing-box on the orlop-deck; its object is to prevent the drag of dead-water impeding the speed of the ship.

From experience, I find that vessels of the form I advocate will carry their weight higher up than those of ordinary build possessing the same length and breadth; that they sail much faster and steer better, are first-rate bad-weather ships, and will scud in heavy weather, and ride, or lie-to, admirably.

They are very easy of construction, capacious, and strong.

They require less curve in their timber, and less timber to obtain the same space; less labour is required to bend the planks into shape, and steam is not wanted; for which reasons this form costs less.

Surely these are advantages; and whenever private gentlemen, or those on whom the heavy, and I may add unenviable, responsibility devolves, of deciding for national purposes what is best, shall desire, I can only say for myself and my partner, Mr. William Miller, that we shall be happy to afford them the opportunity to avail themselves of them.

The price of ships, like most other things, varies with what affects the value of the materials they are constructed of, and that of labour; but I affirm, without fear of contradiction, that 100 cube feet, or "a ton register," which everybody can understand, can be produced by this system as cheaply as by any other. In thus speaking I am safe, for I believe it has been produced for less.

I have only further to tax your patience, Sir, by stating, that, without exception, all the gentlemen who have tried the system are satisfied; and, as a proof, one or two of them have come forward with some others to open a yard to promote the building and more general use of ships built on this principle, and this yard I do hope, ere this summer passes away, to see in full operation; we now only require the patronage of a few more gentlemen, thus to promote, not only what bids fair to be a more than self-supporting system of improvements in ships, but one that would confer on shipowners, merchants, underwriters, and last, though not least, sailors, a real benefit.

In conclusion, I most sincerely thank you, Sir, and the Gentlemen who, with yourself, have done me the honour of so patiently listening to my very homely remarks and explanations.

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Friday, June 1st, 1860.

W. STIRLING LACON, Esq., in the Chair.

RECREATION, WITH REFERENCE TO THE SANITARY CONDITION OF THE ARMY.

By Captain E. S. JERVOIS, Commandant Military Convalescent Establishment, Great Yarmouth.

"ALL work and no play makes Jack a dull boy!"

This is an old maxim, but admits of no contradiction, and I think it will generally be admitted that there is no individual to whom it more fully applies, both mentally and physically, than to the soldier.

It may occur to you that so much has already been done towards the moral and intellectual improvement of the soldier under the present administration, and that the importance of the subject is so well understood by the authorities generally, that there is little need for referring to it at all.

In responding, therefore, to the request of the Council of this Institution to read a paper on "Recreation, with Reference to the Sanitary Condition of the Army," it may be necessary to remark, that my object is mainly to endeavour to show the advantage that might accrue, if the measures now in use could be considerably extended, so as to establish one wide and uniform system of amusement for our army in all situations.

I am quite aware that many commanding officers of brigades and regiments have done much in promoting amusements for the men under their command, and that many valuable suggestions from such quarters have been put aside by the authorities, on account of the expense they would involve. But, if the subject is well ventilated and placed before the public, I entertain no doubt of its being received with a generous approval, especially as it might be shown, I conceive, that any outlay in these matters would in the end be recognised as a wise and remunerative economy, inasmuch as it would tend to reduce most materially the number of sick, to improve the character of the soldier, and make him desirous of prolonging his service, instead of wishing to quit it after his first period.

That such results are attainable there can be little doubt, and it therefore becomes a duty that every one who has the command or management of soldiers should devote his attention to discover the means which are most likely to lead to those ends.

In proceeding with the subject I shall bring before you the remarks and opinions of several persons who are identified with the cause; by which it will I hope be seen that their views terminate in the objects I have suggested.

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To effect much benefit to the soldier, rooms must be provided for him presenting greater attraction than the public-house; let him have the canteen at hand as a place of refreshment only, and, destitute even of a newspaper, he should drink at the "bar;" so that the comparison with it and the "reading and game rooms," and even with his own barrack room, should, by affording ample amusement and cheerful companions, always be manifestly in favour of the latter. Such desirable ends, however, can only be accomplished by some general plan, both as to accommodation and the means of recreation, instead of those which exist at present, viz. that a regiment frequently finds itself placed in a town in Great Britain presenting every temptation to drunkenness and vice, very indifferently provided with barrack accommodation, and with no inducements whatever for the soldier to remain in his quarters.

Similar remarks may be made in regard to hospitals, especially those of a general kind, where men are detained for considerable lengths of time; this has been fully exemplified in that at Yarmouth, and doubtless in many others where attention has been directed to the permission of games, &c., for the men.

It appears to me, therefore, that a general scheme should be organised embracing barracks, standing camps, hospitals, and troops in the field; the latter for obvious reasons would of course be subject to limitation, but should by no means be excluded.

Objections may be anticipated as to expenditure and increase of "train;" those objections however would soon vanish were the experiment made; and we have already seen enough, from the limited measures now in practice, to authorise the assertion, that great and valuable consequences are to be anticipated from their expansion and application to the soldier in every situation.

To carry out this scheme it would be necessary to erect buildings, permanent or otherwise, upon some well-approved plan, at every station, barrack, or camp, for the use separately of each corps or brigade.

In these I would have every inducement placed for the soldier to pass his leisure time in a beneficial manner, keeping distinct the rooms allotted for reading from those in which games or other amusements are practised, so that the men employed in the latter may, without annoyance to those engaged in more quiet occupations, pursue their amusements without any restraint on their hilarity; for, unless the soldier is unrestricted at such times, his enjoyment is materially diminished.

The first opportunity I had of witnessing the extraordinary results of the advantages of games and amusements, as applied to sick soldiers, was in China in the year 1851.

The 59th regiment, then quartered at Hong Kong, was more or less affected with disease throughout its entire strength, partly from the deadly effects of the climate upon the European constitution, but principally from a free indulgence in that most pernicious liquor called by the Chinese *sam shu;* and the *morale* of the men was at so low an ebb, that they did not appear to care what they did or what became of them.

Through the obliging co-operation of the senior naval officer on the station, the old "Minden" (74-gun ship) hulk was placed at the disposal of the general commanding as a convalescent ship, and was furnished with

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games of various kinds, newspapers, &c. The sick were sent on board in detachments, as they became well enough to leave the hospital, and remained there until considered fit to return to their duties.

A similar plan of recreation was adopted on shore; ball and racket courts, cricket, foot-ball, quoits, &c. were provided for the men, and in a comparatively short time the garrison assumed a totally different aspect; the men, instead of assembling in the *sam shu* shops, were to be seen enjoying the amusements provided for them with the greatest alacrity and cheerfulness, and the result was that the moral and physical effects produced were most surprising.

I will now pass on to the year 1858, when, in consequence of the number of invalids and wounded soldiers who were constantly arriving from India, it was considered necessary by the authorities to provide a convalescent establishment for their reception; and, the Naval Hospital at Yarmouth being at the time unoccupied, it was opened in the month of April of that year, and has continued in use with the most advantageous results; having had at intervals as many as three hundred patients under treatment, and at one time there were soldiers of upwards of one hundred and ten different regiments on the strength of the establishment. The hospital is one of the best in the kingdom, covering a space of about ten acres, and close to the sea. It was well supplied, and the utmost care, attention, and kindness, were bestowed upon the patients by all around them; yet, such was the lassitude felt by all, under the unavoidable confinement within the walls,—although its centre contains a fine garden, and there is a terrace overlooking the sea, on which the men are permitted to walk,—that they became dissatisfied, and were continually asking to be sent to their depôts, or to be allowed to go on furlough to their friends; notwithstanding that they were well aware their cases still required the best and most skilful treatment, as well as generous and expensive diet, with rest and quietude, and that their friends or relatives had not the means of furnishing them with these requisites. The question arose, to what was this to be attributed? Purely to the absence of amusement or employment.

The means adopted to remedy the evil were these. Two large rooms, each about forty-three feet long by twenty-four feet broad, and in close proximity to each other, were set apart, one as a reading-room and library, and the other as a game-room; both these were ornamented with flags and pictures of battles and portraits of distinguished men.

The reading-room was liberally supplied by the authorities with books, newspapers daily, and periodicals.

The game-room was also supplied with chessmen, draughts, solitaire, backgammon, and dominoes; and there were only two other games considered necessary to complete the list, a bagatelle and skittle board, which were supplied from a private fund, together with telescopes and writing materials.

The effect produced was quite marvellous; the games were pursued with the utmost avidity, and the tone and manner of the men became entirely changed. Their time no longer hung heavily upon their hands, cheerfulness and contentment were restored, and they ceased to make application for removal, until the medical officers considered them fit to leave.

Having, I trust, distinctly shown the benefits which accrue from the

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introduction of games and other recreations amongst the sick and convalescent, I will next advert to the advantages which might be expected, if the same system were adopted with soldiers who are not sick, in the common acceptation of the word, but who merely suffer from the *ennui*, or lassitude, consequent upon want of employment in their leisure hours.

The manner in which our soldiers are comparatively thrown upon their own resources for amusement, and consequently the amount of crime and disease, principally attributable to drunkenness, simply caused by want of other occupation, can hardly have escaped the observation of those who have lived in a garrison town, or in the neighbourhood of a camp.

A general officer, writing in the Journal of this Institution, remarks, "Neither officers nor soldiers are always provided with means of healthy recreation."

Could not a portion of the spare time of the former be devoted to the superintendence of, and participation in, the recreation of the latter, with the most advantageous results to both?

There is, perhaps, nothing which will so much influence the soldier as any attention which the officers may choose to bestow upon him. It is quite natural that it should be so, for directly you have succeeded in establishing your own mental superiority over the soldier, from that moment you gain his respect; again, as soon as you obtain his confidence, you find that he is ready to comply with your wishes, and do his utmost to serve you. But how is this superiority and confidence to be attained?

First, by proving to him the advantages of education, and taking every opportunity of imparting those advantages to him.

And, secondly, by using your utmost endeavours to show him, that you really take an interest in his welfare, and do everything in your power to relieve the monotony of his existence.

Now a soldier of the present time, after a short experience in the service, becomes a very clear and practical observer in all that concerns himself. Raw recruits in most cases pursue a thoughtless course for one or two years, but subsequently they look around, and begin to perceive the advantages that the well-conducted are enjoying, the increase of pay, &c. attainable by good conduct, and they scan everything that is presented to their attention carefully, and are keenly alive to its advantages or the reverse; and, when you have once impressed the soldier with the conviction that the measures in which you profess an interest are really likely to be productive of benefit to him, he will readily adopt them, and, as before stated, gratefully accept your agency in his behalf.

I have often found that many soldiers who at first look upon games such as chess or draughts as too difficult of comprehension, or too dry to be amusing, were gradually induced to learn and practise them among their comrades in a room at the barracks, and soon found great relief from such occupation and amusement; and herein is a strong reason for placing such recreation within their reach, so as to draw them off from amusements of a more criminal and destructive tendency.

They do not object to learn them under the eyes of their comrades, when they would not attempt to do so before strangers in places of public resort. It is simply to give them easy access to a place where they will

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find amusements at a nominal expense, and conducted upon a non-coercive system, and you will soon find that a soldier is not quite so difficult to please as some may imagine.

There are many who assert that a large proportion of the men of nearly all regiments are a noisy and dissipated set, who cannot be induced to attend schools or day-rooms; but this is the very reason why those who are not so, should not be left to their own resources to become noisy and dissipated also.

That soldiers will voluntarily attend lectures and amusements provided for them was proved to me by the following incident:

Attached to the military hospital at Yarmouth is a small detachment of effective men who perform various duties connected with the establishment, and after a certain hour are at liberty, like other soldiers, to make out the remainder of the day in the best way they can.

It is a remarkable fact that, during the past winter season, whenever a lecture has been delivered to the invalids, upwards of one-half of the above-mentioned detachment have invariably applied for permission to attend also, showing that they preferred an hour's rational amusement to the variety of inducements held out in a town like Yarmouth to spend their evening in drinking and dissipation.

When then you have thus once succeeded in convincing the soldier that there are other enjoyments which will afford him equal pleasure without painful consequences, from that moment you take the first step towards his moral improvement and individual excellence, which is after all the grand secret of an efficient soldier.

The days of old traditions are gone by, and if we intend (which I firmly believe we do) that our army should continue to hold its own, having thrown aside "Brown Bess," we should banish our corresponding prejudices, and teach the soldier to be more independent in action, and worthy of the weapon which has been placed in his hands; at the same time taking every care to ensure him the greatest amount of strength, agility, and bodily health.

In endeavouring to attain these objects, gymnastic exercises may be fairly estimated as a valuable agent; and on this subject I have been favoured with access to the Report of Colonel Hamilton, Grenadier Guards, and Dr. Logan, with reference to their use in the French and Prussian armies. Some extracts from that Report will be the best evidence I can lay before you:—

From Col. HAMILTON'S *Report.*

It is considered desirable that the complete gymnastic apparatus should be constructed, and every part of the gymnastic exercise, when the weather permits, be carried on, in the open air; but, as it is necessary to keep the men daily employed, even in bad weather, a building like a riding-school is also fitted up with some of the most useful apparatus, where the men can exercise at all times.

The total absence of injuries arising from these exercises, which is attributable to the methodical manner in which they are carried on, and the great activity displayed by the men who have gone through the regular course of instruction, leave no room to doubt that, were a similar system introduced into the English Army, it would be highly advantageous to the men. The following are some of the practical results of the exercises:

About twelve men were placed three feet apart, in two ranks, at a few paces from the foot of a perpendicular stone wall eleven or twelve feet high, which surrounds the magazine in the fort. At a given signal the front rank men ran towards the wall, and with the combined exertion of leaping, climbing, and vaulting they cleared it with as

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much apparent ease as if it had been a five-foot wall; they were followed immediately afterwards by the second rank.

Walls averaging from twenty to twenty-five feet in height were scaled, either by means of long poles with a hook at the upper end, or the men would reach the top without any poles, by only taking advantage of occasional holes and irregularities in the surface.

Speaking of the gymnastic exercises in the corps of Sapeurs Pompiers, he says:

The activity, boldness, strength of muscle, and general expertness of the men, as displayed in their various exercises, speak highly in favour of the instruction they have received.

There appears to be an object in every exercise in which they are instructed, and each of them may be brought to bear in some one position in which they may be placed in their occupation as firemen.

From Dr. LOGAN'S *Report.*

From all, the experience gained in the French army is stated to be, that the results of the gymnastic system are to the effect of giving activity and freedom of motion, invigorating the health, proving a means of occupying the time of the soldier, and affording a variety from the more monotonous restraints of their ordinary military exercises, imparting to the many a feeling of confidence and self-reliance in the field, or difficulties of position, all tending to add to the natural impulsiveness, the acknowledged dash, of the French soldier.

These conditions may be viewed as abundantly recommendatory for the introduction of similar gymnastic schools and system in the British army; as means to prove very beneficial in a sanitary consideration, most certainly affording a relief to the soldier, from the little varying and therefore often wearisome routine of his ordinary drills, and by combining amusement with duty.

It would be for the authorites to prescribe the extent and necessary organization of a system of the kind.

It would prove an important sanitary advantage to the soldier to have his muscles and sinews braced up by such physical training.

Colonel Hamilton concludes the Report by observing—

It is doubtful whether the introduction of a regular system of gymnastic exercises, to form merely an addition to the drill of the English soldier, would be accepted as a boon; but it would not be difficult to make such regulations with regard to them as would cause their introduction to be looked upon as a relief from the monotony of a soldier's barrack life, while it would materially contribute to his health.

It appears therefore that the practice of gymnastics should be introduced more as a recreation, and, if as an established system, that it should be voluntary, rather than compulsory: the constitution of our army being so different to those of the powers alluded to in Colonel Hamilton's Report.

It is scarcely necessary to comment on such amusements as cricket, quoits, foot-ball, fives, and other out-door games. Their advantages are already thoroughly admitted, and I would here beg to refer to notes on the subject by Colonel Lindsay of the Guards.

Fives Courts.—When well-managed, I have found them much used in summer and autumn. They sometimes fail, as the men lose their balls, and it is nobody's business to provide them for sale to the men; but, when this has been done, the men are glad to have the recreation. Fives courts have been erected at several of the large barracks in the country, and with success.

Skittle Courts.—At Dublin, in the Royal Barracks, there are two provided for the regiments therein; but they are not generally provided by Government. Whenever out of London, I have always induced the officers to bear the expense of establishing two for the men, and it has been attended with full success.

Gymnastic Exercise.—(About to be established.) I believe that I originally was the mover in this direction five years ago, at Aldershott; and in the House of Commons, on

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Army Estimates, I applied for and succeeded in getting wood and iron allowed to erect poles and bars; but, my battalion being removed, I never used them. If conducted upon a regular system (that is, a course of systematic instruction), it is calculated to afford not only recreation, but the development of the physical faculties of the soldier in many points most essential to him.

Draughts, Dominoes.—I got each captain of my battalion to give his company three sets of each of these games; they are much used, particularly in winter.

Chess.—Very few I find can play.

Quoits—Every captain of a company provides two sets of quoits. The men keep them up.

Games, Running and Hammer-throwing.—We constantly get up competition among the different companies; in addition to this, whenever at out-quarters we give a whole day for all sort of games. The officers subscribe from 15*l.* to 20*l.* towards this object.

Foot-ball is encouraged during autumn and winter. The effects of these various games when out of London is great. The in-door games have their effect in London; but the opportunity for those of an out-door character is small, and town life makes much difference in the habits of the men. But games and recreation have the best effect upon the spirits, health, and discipline of the men. It has the effect of taking away a sort of *ennui* which routine always *must* engender, and the monotonous life which a soldier in a garrison leads. It is calculated to make him more contented while serving, and to do his ordinary duty with cheerfulness, from a light-hearted disposition. I do not think too much can be written or said in favour of recreation. Eight hundred human beings cooped up in a small space, sixteen always occupying the same room, are likely to become worse by mutual contact and communication, instead of improving, unless something is done to counteract vice, and to make their lives pleasant. Recreation is one of these elements. Library and Reading Rooms, and opportunity for smoking in barracks, are the others, combined with regularity and discipline—in fact, to render a "second nature" caused by discipline, agreeable.

(Signed) J. LINDSAY, Colonel.

Now, it is the *in-door* and *evening* recreations I wish especially to direct attention to, in order that the barrack-room, or at least the buildings connected with it, may form a recognised *home* for the soldier.

If we look at the attractions prepared in all large towns in which he is quartered, to entice him into places of public resort, not merely "beer-shops" or ordinary public-houses, but those affording every species of amusement and temptation, such as billiards, cards, and dice, with music, dancing, and singing, we must find an all-powerful argument for increased exertion in providing amusement for him in the barracks, in such a manner as to induce him, if possible, to remain there during those hours after the evening meal which are left entirely at his own disposal.

And here it may be asked, What is there at present to induce him to do so, or to return to his barrack until the last moment, in comparison with what he finds in the places of public resort I have alluded to, and into which he is easily inveigled, and finds every inducement to renew his visit?

There are music-halls and concert-saloons at Portsmouth, Plymouth, Aldershott, and Yarmouth, and most other military stations.

It may be asked, How does the soldier find means to attend these places? It is not presumed that he can do so every night. But there is not the slightest doubt that a large proportion of the men in those towns and the camps seek such places of amusement, and spend their money in them, whenever they have any; and in too many instances are led to sell their necessaries to follow them up.

How important must it be, then, to provide a building close at hand, in which the soldier may find amusements equally attractive and less pernicious. Of its success no doubt can be entertained, more particularly in

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winter, when he would gladly remain within the precincts of the barracks, rather than be at the trouble of dressing (as he must do) to go out. But, when he finds himself left in a dreary, dimly-lighted barrack room, destitute of amusements, he will, if he has a penny in his pocket, try to escape from it and join the gaieties of the town.

Should it be remarked that the library and reading-room is available to the soldier, it may be stated in reply, it is so; but our argument is, that the above-mentioned room, although valuable in itself, does not contain amusements sufficiently attractive or varied to induce a large proportion of the men to avail themselves of it. Some are incapable of using books or newspapers, by reason of inability to read. Some have not acquired a taste for literary pursuits, and *these* are the men who seek refuge in the town or public amusements, and who, by associations they incur, are led into drunkenness, crime, disease, and desertion.

To exemplify this I shall here introduce an extract from the Report of the Commissioners appointed to inquire into the "Regulations affecting the Sanitary Condition of the Army."

Colonel the Hon. J. LINDSAY *examined.*

5876. The question was put the other day to an officer, and he said that he did not see what the men would do with a day-room.

Colonel Lindsay.—We had a little experience of that the other day, before the new Wellington Barracks were occupied. There were two new school-rooms built in the Wellington Barracks for two battalions, and before the new part of the barrack was occupied the battalion that occupied the old part had the use of the extra school-room—and a very large room it was, I should think 50 feet by 30—that is, about double the space there is in any reading-room I ever saw attached to a barrack. It was watched to see whether this room would be used, and it was *crammed*, even that large room, so that there was not room for the men.

By the Committee,—Was it in the daytime or night?—Both.

Was it lighted with gas?—Yes.

What did the men do there?—They read and took their books there, and smoked.

Had they any games there?—Yes, draughts and dominoes, and those sort of things.

Do you allow cards there?—Never.

You do allow smoking?—Yes, we always allow smoking in our reading-rooms.

I will now read a letter I have received from an officer connected with Scutari Hospital during the Crimean campaign, and which I think completely confirms the evidence given by Colonel Lindsay before the Committee.

DEAR SIR,

I very much regret that the papers I have preserved give me very little assistance in answering your note of the 1st. All I can state is, that during the summer of 1855, when public stores became abundant, and the sick at Scutari were provided liberally with everything ordered for them; when, in consequence, the "Times Commissioner" (the kind-hearted and accomplished Mr. Stowe) could find no occasion for spending the private funds at his disposal any longer on behalf of the sick, he determined, on the recommendation of a friend, to get up a place of amusement for the convalescents forming the depôt.

There was at the time no place of recreation at Scutari for these men; and hence the low *raki* shops in the High Street were constantly crowded, and a large amount of drunkenness prevailed. The idea was warmly supported by Miss Nightingale, the General (Storkes), Dr. Lawson, and others; a committee was formed; a very suitable and commodious building erected; and a *café* opened, under the superintendence of an intelligent person engaged for the purpose.

The *café* was furnished with newspapers, books, bagatelle boards, chess, draughts, and

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every other available amusement. From its opening it was well attended, and as long as it was under the management of the committee continued a great source of recreation to the depôt. Mr. Stowe died in Balaklava Hospital, soon after he visited the Crimea, in the same year; and the *café* was ultimately disposed of to a Greek gentleman.

During the winter of 1855, lectures were delivered by several officers and medical gentlemen for the instruction and amusement of the men. These were well attended, especially when the subjects were of an interesting character, and illustrated by experiments.

But there was one—I believe, only one—drawback to all these efforts: they were made at the expense of private funds, which were wholly inadequate.

Had the soldiers been furnished with the means and provided with the opportunity of spending their time, either at athletic sports or intellectual occupation, furnished liberally at the public expense, I believe an immense moral and physical benefit would have resulted, and much sickness and many other evils would have been prevented.

I now wish to introduce to your notice two plans, very simple and unassuming in their pretensions:

The first (Plate I.) is a plan of a building I would suggest should be attached to every barrack in the kingdom, and proportionate in size to that of the barrack. The exterior would be plain and inexpensive; the interior equally so, except that it would be fitted up with games of every description, and pictures of remarkable men. To this I attach great importance as having a tendency to raise the *morale* of the men; and I have found they take the greatest interest in the pictures, if they are of an attractive kind. A small refreshment room or bar attached, where the men could obtain tea, coffee, and tobacco at a low rate, and on the same plan as that adopted at Chatham, would also be a most desirable adjunct.

In this building, which I would denominate the "Game or Recreation Room," I would afford every facility for concerts, lectures with illustrations, competitive exhibitions of fencing, theatricals, &c. and would allow the regimental band to play on those occasions. I would have the games in the first instance provided at the public expense; and the men could subscribe 4*d*. or 6*d*. per month towards their support. I would engraft the room on the regimental system, and place it under the superintendence of a trustworthy non-commissioned officer, and make it the duty of the orderly officer and captain of the day to visit it whilst going their rounds.

The second plan (Plate II.) is on a more extensive scale, and is better adapted for a garrison or camp; combining gymnasium, library, reading-room, and game-room, also quoit and skittle grounds, rackets, and fives courts; but it is on too large a scale for a single battalion.

The next question I propose to introduce to your notice is, How are amusements to be adapted to the circumstances of an army in the field? At first sight it may appear almost an impossibility. If occupation for the mind and body be desirable in quarters, the same advantage may be looked for in camps on service; I would then suggest that marquees, solely for the purpose, should be carried and attached to the lines of each *corps* or brigade.

The expense of additional carriage will no doubt be objected to, as well as the difficulty at times of procuring it. Such objections ought not, however, to have sufficient weight to preclude arrangements being made for some means of recreation accompanying every force, even though its use might occasionally be interfered with or suspended in operation.

When troops on service are in motion their time is pretty well occupied,

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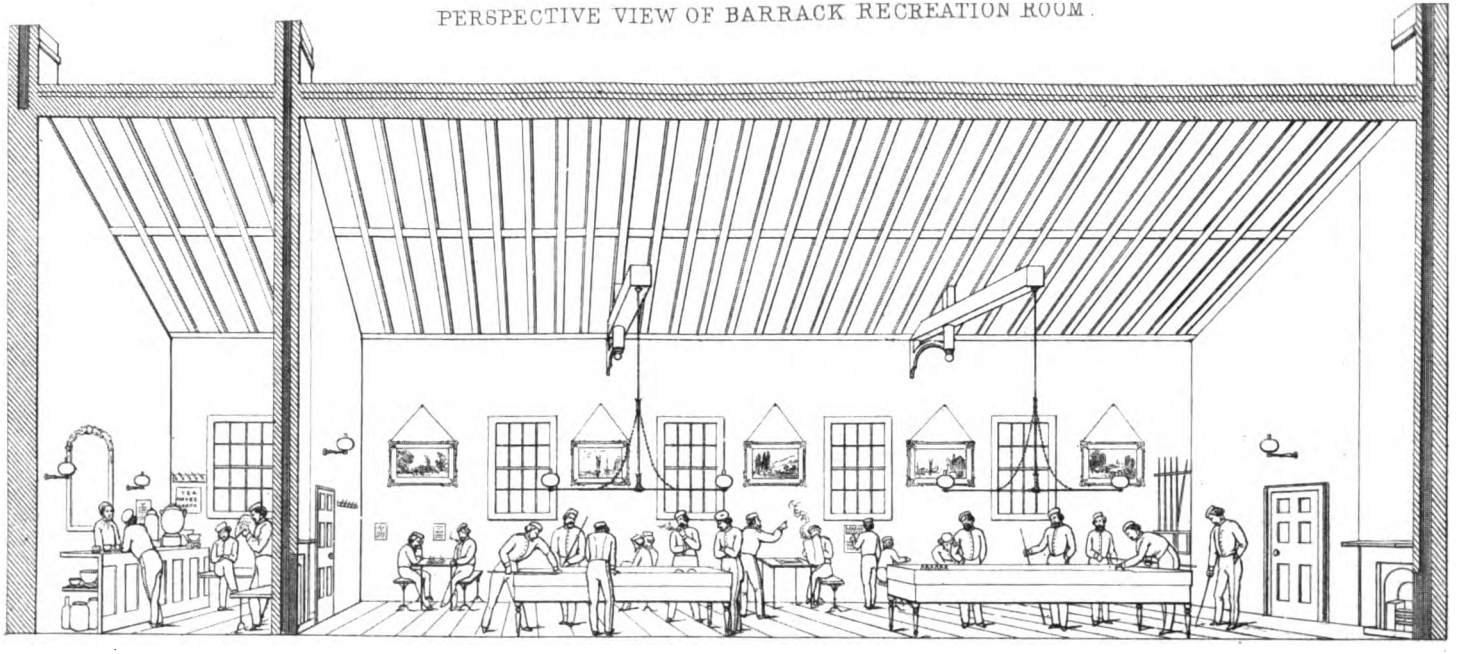
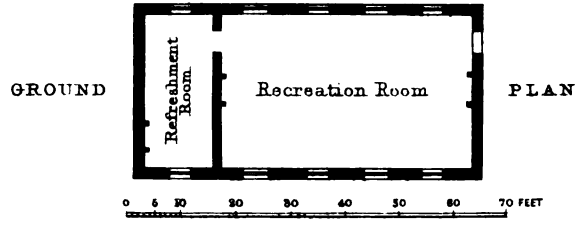
PERSPECTIVE VIEW OF BARRACK RECREATION ROOM.





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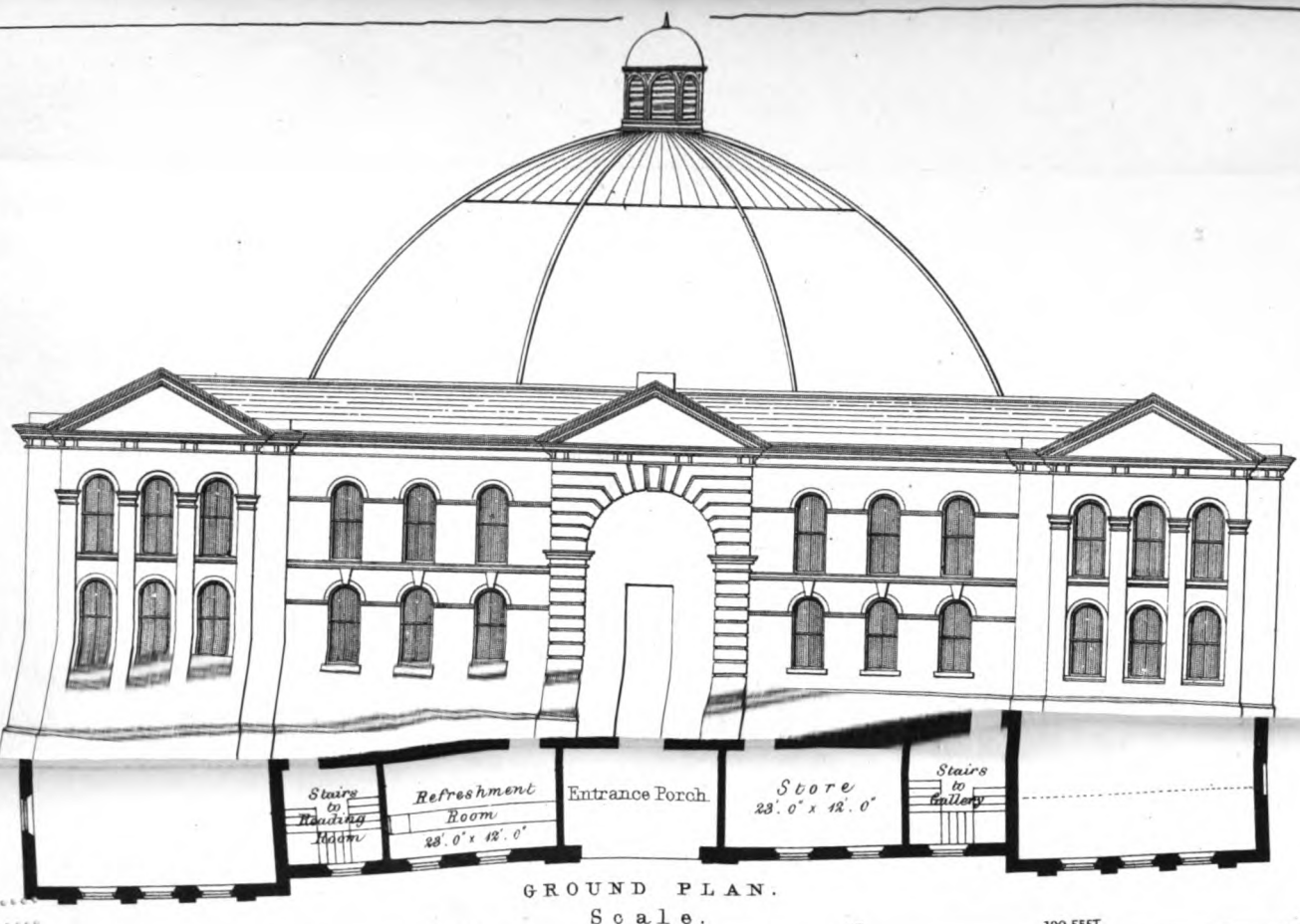

GROUND PLAN.

Scale.

0 5 10 15 20 25 50 75 100 FEET

J.R.Jobbins.

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quently too fatigued to need amusement. But when a field
tationary for any protracted period—Varna, for instance,
been informed by medical officers, the deficiency of any
ion added tenfold to the horrors of the terrific outburst of
place, and which indeed may be collected from the published
y of that war—the machinery for recreations would be
t after; men, under such circumstances, having but little
less employed in throwing up field-works.

nees should be furnished with games of every description, tea,
bacco, with every facility for theatricals and lectures, and con-
ar as possible, on the same system as the game-room in

games, also, should be established for out-door amusement,
en are not required for any particular duties.

Results.

uees of the above description were provided and attached to every
in camp, it would be found that, instead of the soldiers, after the
the day, congregating in the canteens and other places of equally
notoriety, they would find inducements to amuse their minds in
ys.

army in the field will always have a large proportion of sick and
ves as long as the men are destitute of any kind of provision for
mporary comforts, and no attempt made to allure them from their
favourite haunts. A soldier's mind when unemployed in the field
state of vacuity and restlessness. He must go somewhere to relieve
sui, and, having no place provided for him, he goes where he must
bly contract the seeds of disease, and render himself utterly useless
profession.

ere the experiment tried, there is little doubt that the results would be
satisfactory. The men would become more rational and expert,
ly from not having imbibed the usual amount of bad liquor, and from
ng employed their time in thinking how they could play their next
ino, draught, or chessman; which would also lead them to reflect be-
they wasted a rifle-ball in the air.

t may be adduced, that the marquee would be a great incumbrance to a
iment in the field; and, secondly, would cause great additional expense
the public.

In reply, it may be asked, Which would be the greater incumbrance—the
arquees for amusement, or the marquees for the sick? Which would be
e most costly—to have a large proportion of your men in hospital, and
herwise ineffective, with every kind of additional expense attending it, or
o have an efficient body of men free from disease, and ready to march at
a moment's notice?

If these two questions were fully entered into, it would in my belief be found, that both the incumbrance and expense of a marquee for the amusement of soldiers in the field would be more than counterbalanced by the expense and inconvenience of a large proportion of sick in hospital.

It is frequently adduced by persons familiar with the economy of hos-

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pitals, that they pay their own expenses; the stoppage from the man, 10*d.* per diem, covering the outlay for diet on the aggregate. This I believe to be the case, so far as the subsistence of the man is concerned; but it must be borne in mind that, in addition to the loss of the man's services, hospitals are maintained at great expense in the buildings, clothing, stores, medicines, instruments, fuel, washing, &c. besides the pay and allowances of those connected with the establishments.

We may sum up, therefore, in a few words. The results of increased facility for recreation would appear to be:

1st. More amusement; less drunkenness.

2nd. Less drunkenness; less crime.

3rd. Less crime; fewer hospitals and prisons, and, consequently, a great increase of effective men, as well as less frequent recourse to flogging among troops in the field; and, I believe, an actual saving of money.

There is an old saying, "Penny wise and pound foolish." A cheap soldier is like a halfpenny doll purchased at a country fair, which falls in pieces directly its arms and legs are stretched; whereas, had a penny been given for it in a respectable toy-shop, it might have afforded amusement to the child "until it was time to put away childish things." If we, as a nation, want a "good article," as the shopman says, we must pay for it: and, could a better class of men, such as those who constitute the bulk of our mechanics, be induced to enlist, and then be supplied with every aid that art and material can give him, to insure his activity and health, both mental and bodily, I think it would be found that the proverb would be fully verified; and I believe most strongly that the extended plan of recreation I am now advocating would be found, not only a great inducement to such a class to enlist, but would subsequently render even this better class of recruit a more valuable and efficient instrument for applying our new, improved, and expensive weapons.

In the outset it was my intention to have gone into statistics and matters of finance, but to do so would perhaps prolong these remarks beyond their proper limits; and it would be difficult to arrive at any very accurate estimate of the outlay required to carry out a more liberal and extended system of recreation for the soldier under all circumstances.

It is sufficient at this time to bring the subject more prominently to view. Its own merits and decided claims to the consideration of the public are acknowledged by all who are in any way connected with soldiers; and, if that merit and those claims are put forth in a manner calculated to extend its benefits, they will unquestionably be encouraged and supported by the country.

In concluding these observations on the necessity for, and the advantages of, recreation, exercise, and instruction for our army, and which have, already, been in some degree established, I trust I shall not be trespassing on the position I am in, by expressing a hope for the success of those measures.

It is evident that the Government and those entrusted with our military administration are deeply interested in the matter; and that they are promoting and encouraging everything that tends to the welfare, comfort, health, and efficiency of the soldier. And I believe it is equally clear that they are circumscribed in their efforts, and that considerations of economy

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are continually forced upon them, and operate as a check on their best intentions. This can only be remedied by liberality in the legislative bodies, and on the part of the nation.

I can scarcely hope that my feeble efforts will have effect, further than bringing the subject under notice; but they may be so far of service as to lead others of more weight and influence to take up the cause; and I am satisfied, it only requires to be plainly set before the public, to ensure their full and generous support.

At the present moment, the defence of the country is the all-absorbing topic, and surely no time can be more propitious for us to consider how we can devise means to render our army and navy our best and strenuous defenders.

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Evening Meeting.

Monday, April 16, 1860.

Admiral SIR GEORGE F. SEYMOUR, K.B., in the Chair.

Names of Members who have joined the Institution since March 19th.

Hall, J., Capt., Paymaster 22nd Depot Batt.
Graydon, G., Lieut.-Col. Royal Artillery
Jebb, F., Capt. 67th Regt.
Pearson, C. K., Capt. 3rd Buffs
Pigott, F. P., Capt. 16th Royal Lancers
Butler, H. T., Ensign 58th Regt.
Hozeir, J. W., Cornet 2nd R. N. B. Drags.
Hutchinson, J., Capt. 8th Lanc. Rifle Volunteers
Vicars, H. J. A., Capt. 18th Royal Irish
Ouchterlony, J., Capt. Madras Engineers
Doorly, M., Quar.-Mas. 3rd W. I. Regt.
Lyon, F., Capt. Royal Artillery
Legge, Hon. A. K. H., Lieut. Royal Navy
Downes, H. F. Esq., Army Agent
Norman, H. W., C.B., Lt.-Col. Bengal Army
Clarke, A., Major-Gen. Madras Army
Webber, F. W. S., Lieut. 45th Regt.
Graham, H. A., Lieut. late 7th Fus.

ON FLOATING HARBOURS OF REFUGE.*

By Captain Claxton, R.N.

Abstract.

The Paper commenced by calling attention to the annual loss of life and property on our own coasts by shipwreck, which Captain Claxton said had for many years averaged eight hundred souls, while, through the wreck of the Royal Charter, and another passenger vessel, it had increased to sixteen hundred in the twelvemonth just passed. Connected as he had been with civil engineers, it had been propounded to him that their Institution was the proper arena for the discussion he hoped to elicit; but in that he did not agree, first, because he looked upon the subject quite as much, if not more, as a nautical than an engineering one, albeit he admitted the combination; and, secondly, because such was the nature of the Papers and Lectures read, and of the matters discussed, in the Royal United Service Institution, that for imparting knowledge he considered it second to none in this great metropolis.

The Lecturer then rapidly glanced at the evidence given on the question of harbours of refuge and shipwrecks before Committees of the House of Commons and Royal Commissions. He cited the evidence of scientific persons and the Reports of Commissioners down to 1859–60, of which Admiral Hope was chairman, and which recommended the expenditure

* Since the foregoing paper was read, a Committee of the House of Lords sat on the question of Floating Harbours, examined witnesses for and against, and ended by recommending that ten thousand pounds should be granted to the Admiralty for making floating experiments.—C. C.

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of about two and a half millions of money for one or two harbours of refuge, on the East coast, another at the mouth of the Bristol Channel, and a few alterations or additions elsewhere of already existing harbours.

If the plan recommended by Captain Adderley Sleigh, and backed by several well-known nautical men, were found to answer, the sum of money required to be expended would, in seven or eight fathoms of water, be less than a fifth of that required for stone barriers, and in deeper water, while Sleigh's remained always a *constant* (except a few fathoms more of moorings), the difference of cost would increase, *pari passu* with the depth, up to twenty fathoms, when stone would be in excess as about fifteen to one. What he hoped to see was a trial made, which might be done at the cost of about six thousand pounds for one hundred yards in any depth, while in stone, in eight fathoms, forty thousand would have to be expended on the same length.

If Professor Airy might be admitted as a competent judge, what he had said in evidence ought to go far to satisfy Captain Sleigh, inasmuch as he affirmed that there was five hundred times less disturbance ten feet below a ten foot wave than at the surface; and twenty foot below, one thousand times less; and, if weight were due, this, he thought, settled the question, because all that was required to be found out as to Captain Sleigh's plan was the draught of water necessary to counteract the incoming swell which carried the breaker. He was of opinion that a depth of twelve or fourteen feet would be enough almost anywhere on our coasts. At the Land's End, or thereabout, and on the West Coast of Ireland, in westerly and south-westerly lasting gales, a greater depth might be necessary, which could always be given if the importance of the site justified the increase in cost.

The preponderance of opinion, instancing those of Messrs. Rendel, Coode, Calver, and other engineers and nautical men who had given evidence, went to shew that there was little or no disturbance about twelve feet below low-water mark at Plymouth, Holyhead, Portland, and elsewhere, where breakwaters had been erected, albeit there were some contradictions the other way. He was for trying anything that had been invented or projected that promised a chance of saving life, and, seeing how impossible it was to find the money for large stone barriers in the many places in which they were required, to say nothing of silting up, and constant repairs, he thought it probable that a cheaper substitute might be found to answer.

He dwelt largely on the wave-screen of Mr. Calver, and eulogised his pamphlet, but, while disagreeing with him in condemning every kind of breakwater, fixed or floating, except his own, he (Captain Claxton) would be glad to see that also tried. He had in a way tried it himself successfully in protecting the "Great Britain" in Dundrum Bay, a drawing of which he produced.

He next went into the objections which had been advanced against floating barriers; their cost; the wear and tear; the doubt as to anchors and moorings holding; the improbability of their resisting the attacks of seas and breakers, and the great probability of their breaking adrift and carrying with them the vessels under their shelter. As to moorings, he said that nautical men must discard every idea as to any similarity between the mooring or anchoring of ships, and these contrivances. The hawse-holes of ships were many feet above water, varying from seven or eight to fourteen or fifteen, according to the ship being light or loaded, whereas, in

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Captain Sleigh's craft the hawse-holes were ten, twelve, or fourteen feet under water, at the very bottom of the stage. The friction, unlike that of the chains of the ship, which was great from the plunging into or rising over the seas like Light Vessels, or Trinity buoys, which were always chafing, would be here little, or he believed nothing; in Sleigh's there might (and even that he doubted) be a slight tightening and slacking of the belly or bight of the chains, and that he thought would be all. Supposing the mooring-chains to be equal to a ten-cwt. anchor, or one inch, the anchors might be equal to two and a half inch chain, and, in fair holding ground, could never start, or they might be backed in doubtful ground.

The attacks of the seas would, he thought, be trifling on the smooth inclined plane. There might be times when it might rush up the whole width, and possibly plump into the haven, and what then? Just nothing! froth and nothing else—no disturbance. As to their breaking adrift, he pronounced it next to impossible. Each section of 200 feet having four anchors to seaward, and each section attached to its neighbour, and if a vessel rushed upon one and smashed it up, it need not come under the lee, except in splinters. He thought there was infinitely more risk from one vessel driving in Yarmouth Roads, or the Downs, on those to leeward of hem.

Then, from one of these sections of the breakwater, three lighthouses, he said, would be on each series, one at each entrance, and one part most seaward. He thought the whole barrier might be considered as sacred as lighthouses were considered by nations even in war time. They would save the lives even of enemies in extremes. With regard to cost, the interest alone of the money expended on such breakwaters as Plymouth, combined with the annual outlay to keep it in repair, would renew moorings, anchors, and a whole set of Sleigh's sections, of similar extent, if found necessary, every three or four years. But he was prepared to show that, with proper attention, creosoted timber, and careful repairs in the summer, they might be made to last longer than the oldest ships—from half a century to a whole one. And, as to the moorings, where there was no friction, there would be no wear, or comparatively little, and forty or fifty years with summer overhauling, taking up and varnishing, might be their duration. Their actual cost being about a fifth or sixth of the whole.

All he wanted was a trial—an experiment—and he thought, now that we had lost the rearing of apprentices, we could not be too chary of the lives of our seamen, and most particularly as all foreigners, to the cost of the British shipowner, were encouraged, and a preference given to sailors of all nations over those of our own.

Captain Sleigh then explained the principle by a reference to a large number of drawings and diagrams, which were used for the occasion, and stated that at that moment he was engaged in preparing plans for laying down a series at Hastings.

Vice-Admiral Tayler, C.B., then said, that, as the paramount object of the meeting was to call forth the opinions of nautical men, he would confine himself entirely to practical data, which had already proved that floating breakwaters are capable of being securely moored. He had devoted more than forty years' attention to breakwaters, and was perfectly acquainted with the principle of the one in question. He had been successful himself

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in establishing one at La Ciotat in France during the time of Louis Philippe. Fourteen sections were placed down off a pier that had been injured by the violent breakers upon that coast. After the sections were down four years, the French Government ordered a report on them to be made, and several of their scientific men attended, M. Arago, Admiral Dupré, Minister of Marine, and Marshal Soult among the number. The breakwater was so fully approved, that an order was given for forming one at Havre, a mile and a half in length. A chart was prepared for the purpose just previous to the Revolution of 1848. There was a fine manufactory of steam boats and steam engines at La Ciotat belonging to Mr. Mackenzie, and when the Revolution took place the mob burned it down, and they afterwards went and broke off the heads of the breakwater, and added it to the flames. Admiral Tayler lost £3,000 by the affair. However, Marshal Soult said he had no doubt the breakwater would perfectly succeed, and asked, in the event of war, what would become of them? Admiral Tayler replied, "that an international law might be passed, and that they might be made inviolable, like lighthouses."

ADMIRAL TAYLER then said that, without taking up much time, he would come to the practical part of this subject. Theory was of very little use in everything connected with the sea. All knew that the British Navy gained everything by practice, and nothing else. The origin of floating breakwaters was due to a French general, who invented one previous to Plymouth breakwater, and, by permission of the French government, tried every experiment with it and failed; and failed for a very simple cause. It was simply a breakwater with a base of from 40 to 200 feet. It was on an incline plane like a beach, and he found that as long as the breakwaters remained in a horizontal position, not rising and falling with the undulations of the waves, the water ran up them, that was when the wind and wave were in a direct line; but that when the wind set upon them in an opposite direction, acting as a kind of lever, and the sea ran up the slope, it naturally slewed them about in such a manner that no woodwork could stand it. The project was consequently abandoned. Afterwards Mr. White laid out a large sum of money in making another at Dover. He brought his six feet under water, and he thought that would be quite sufficient. The breakwater was put together; but, in a gale of wind, he found that, as a great number of the sections were in the hollow of the sea, the water came up them, and that the pressure was equal to 8,000 tons on a section, besides the moorings; and as the water rose to the top, it tore the woodwork to pieces. He could not moor it, for the sea got underneath it, and hove it all up with the anchor out of the ground. He therefore abandoned it.

It would give him (Admiral Tayler) great pleasure if anything could be devised to dispense with the enormous cost of stone breakwaters. A Royal Commission had been appointed to inquire into the question, and Mr. Calver, who was opposed to all kinds of breakwaters, was appointed secretary. He adopted his patent for inshore breakwaters, which had the effect to set aside all others. But he was sorry to see that Mr. Calver had condemned *in toto* floating breakwaters. But if all floating breakwaters had failed, what right had we to imagine that his theoretical wave-screen would succeed?

ADMIRAL TAYLER then explained his breakwater that was laid down

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in France. It was somewhat in the form of a double prism, and consisted of a network of massive timbers, securely fastened together. It was launched broadside on, and towed out in that manner, and the moorings went through the keel. It was intended to resist breakers. The body of the breakwater was open, and full of inert water; and, this water being inert, of course the water to leeward was quiescent. Consequently, when the sea broke upon it, there was a solid body of water to break upon, the same as a wall. The breakers could not press it down, because the water had to pass through the interstices, and, as the moorings which passed through the keel acted as ballast, it always rose to the perpendicular, and no ship passing over it could destroy it.

He then explained that if a smooth basin was wanted, he could form an artificial bar of earth and stone, and fill it up with rubble. He brought that up to five feet of low-water mark, and filled it up with sand. He proposed to put an iron barrier upon this sand bar. He could form a harbour at Dover on his principle, with a pier for Armstrong guns, in three years, for 300,000*l.* whereas the present harbour of refuge would probably cost the country 5,000,000*l.*

In answer to a question from the CHAIRMAN—What was the depth of water at La Ciotat, where his moorings were laid down?

ADMIRAL TAYLER said that it was about 45 feet.

In answer to a question from CAPTAIN ADDERLEY SLEIGH—What became of his breakwater at Brighton?

ADMIRAL TAYLER said it was broken up, but not broken up by the sea. He received a letter from the Admiralty to go and lay down his moorings, but the Admiralty could not let him have a steamer for the purpose at that season of the year, nor even a boat. He had to get a billy-boy boat, and take it down to Shoreham. He took out the chains one at a time, laid them down, buoyed them, and fixed them; but when he came to lay down one of them he could not find the buoy—it had been cut by some small vessel. He got a small anchor, and a government chain, and moored it with them. It rode a winter and a half with that small chain, then the chain gave way; and such was the strength of the breakwater, that it came back on the other and rode out the gale, and was very little damaged. He put it on the beach, and there it remained, proving to the most sceptical its strength, adaptation, and durability.

CAPTAIN CLAXTON said that Admiral Tayler had alluded to a breakwater like Captain Sleigh's, which the sea rolled under and lifted up; but he said that it only drew six feet of water. They took theirs down twelve feet, which made all the difference. Their architect said the breakwater would be so strong that no sea would ever destroy it. It had a double deck diagonally placed, and caulked like a ship's deck, and could be made as strong as necessary. They had seen the President of the Board of Trade upon the question whether dues for breakwaters could be levied, because the Company would not go on until there was a power to levy toll on vessels using the shelter. They intended to put one up at Hastings, to prove whether it would do or not.

In conclusion, the CHAIRMAN thanked Captain Claxton, Captain Sleigh, and Admiral Tayler, for the clear statements they had given of their respective plans.

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Evening Meeting.

April 30, 1860.

Colonel the Hon. JAMES LINDSAY, M.P., in the Chair.

NAMES of MEMBERS who have joined the INSTITUTION since April 16th.

Nott, A. H., Capt. Indian Navy
Miller, W. V., Paymaster Royal Navy
Hamilton, Sir E. A. Bart., Lieut. Cold. Gds.
Chelmsford, Lord, late Royal Navy
Blyth, W. D'Urban, Capt. 14th Light Drags.
Campbell, R. M., Capt. Roy. Elthorne L. I. Mil.

ON A NEW PRINCIPLE FOR THE PROTECTION OF RIFLEMEN.

By Francis Galton, Esq., F.R.S. &c.

A and B (fig. 1) are two combatants, armed with similar rifles or muskets, and firing at one another, over parapets not less than 100 yards apart. I propose to show that a screen may be interposed by one of them, A, that shall not affect the view which either party has of the other; that shall in no way prejudice A's power of hitting B; but which shall make it wholly impossible for B to hit A (by direct fire).

It is well known that the course of a projectile does not lie in a symmetrical curve, but that its *descent* is more rapid than its *ascent;* in fact, at average ranges, in the case of the Enfield rifle, it is nearly one-half more rapid; and in the case of a common musket ball, the ratio is still larger. Consequently, the trajectories of A's and B's shots, fired at the exaggerated elevation represented in fig. 1, and having a range A B, would follow pretty nearly the curves there represented; whereby it is clear, that a ball-proof bridge, W, would have the effect asserted to be possible. A's bullet would pass out under the bridge, but B's bullet would strike against the bridge.

In short, I wish to point out the advantage of firing at an enemy under horizontal bridges, placed some yards in advance.

We will proceed by examining into the precise facts of the case—into the actual angles of ascent and of descent of the Enfield bullets, at different ranges, and will thence deduce the precise amount of effective cover which the arrangement I propose might be made to afford.

I have compared with care such data as I could obtain upon the trajectory of the Enfield rifle, and believe the following tables will be found substantially correct.

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In fig. 1—

A *h* B is the line of sight between A and B.

A *b* is the first part of the course of A's bullet, towards B.

a A is the last part of the course of B's bullet, towards A.

b d is the last part of the course of a bullet from B, so fired as just to skim the under surface of W.

Then no bullet fired by B, which passes under W, can possibly hit K higher than *d*.

In cases such as those with which we have to deal, A *a*, *b* A, and *b d*, may all be considered as straight lines, and not as parts of curves; and *a b* may be considered as equal to the distance between *d* and the top of the parapet K.

In computing the following table, A *h* has been taken = 1000 inches, that is, about 28 yards.

Yards Range.	Angle of Ascent.	Angle of Descent.	A *h* = 1000 inches = about 28 yards.		
			b h, inches.	*a h*, inches.	*a b*, inches.
	° ′	° ′			
0	0 0	0 0	0·0	0·0	0·0
100	0 12	0 22	3·5	6·4	2·9
200	0 24	0 42	7·0	12·4	5·4
300	0 38	1 7	11·0	19·4	8·4
400	0 54	1 33	15·7	27·6	11·9
500	1 13	2 8	21·2	37·4	16·2
600	1 32	2 41	26·8	47·5	20·7
700	1 55	3 25	33·4	59·0	25·6
800	2 22	4 10	41·3	73·0	31·7

It is upon the existence and the amount of *a b* that the protection, which W can afford, depends. I will now explain what appears to me as the simplest method by which a rifleman may avail himself of it.

I trust it will be distinctly understood that I do not venture to propose any particular description of shield; but that I confine myself to enforcing a principle, leaving its application to others. I am the more inclined to do so, as persons better informed than myself have suggested that extemporaneous contrivances would be, probably, the most feasible. A man crouching on the ground might fire below a gabion, or some equivalent for a gabion, laid crosswise upon two others and placed twenty or thirty yards in advance of him. There are cases where he might avail himself of the cover of actual bridges, or where, when sheltered in a building, he could stand far away from one of the windows, and so select his position that his bullet should skim below its topmost edge. Yet, while I do not pretend to advocate any regularly constructed piece of mechanism, I feel it will enable me to convey my meaning more precisely if I describe, as I will now do, some one arrangement that would undoubtedly give protec-

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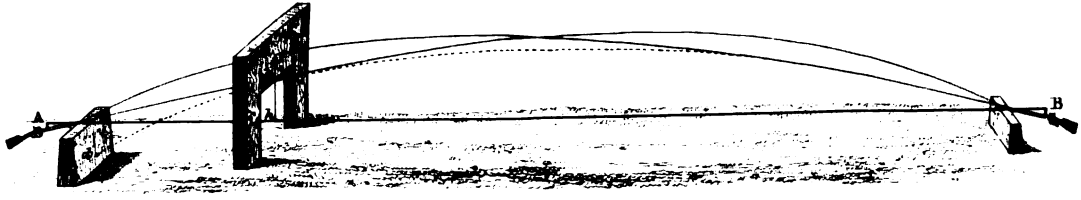

Fig. 1.

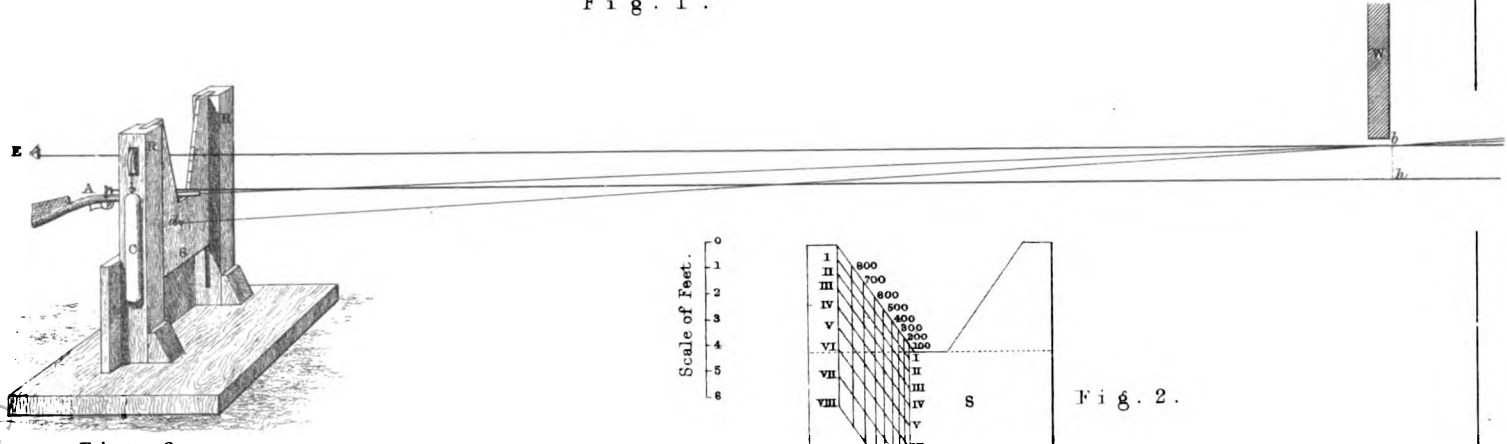

Fig. 3.

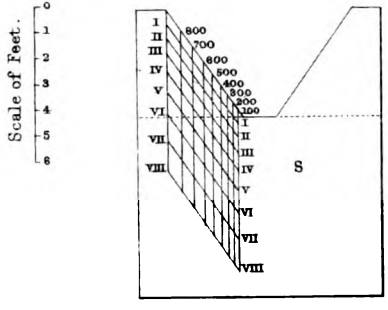

Fig. 2.

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tion, and would also be well calculated for purposes of experiment on the truth of my figures.*

Figs. 2 and 3 represent a solid wooden "sash," S (like a window-sash), covered in front with wrought-iron plates of not less than one-eighth of an inch in thickness. It slides up and down between two supports, R, R, and is balanced by counterpoises, (one of which, C, is seen in fig. 3,) precisely as a common window-sash. This machine is placed 28 yards behind W, and the rifleman, A, stations himself behind the sash. He is supposed to fire, resting his weapon upon S, at the level of the dotted line (fig. 2), and the machine takes the part of K in fig. 1. The figures 800, 700, &c. standing for yards, will be observed upon the sloping edge of S (fig. 2). They are written *outside* of the sash, because the smallness of the figure made it impossible to insert them legibly upon it.

The object of them is to instruct A as to the elevation he may give to his sash, without obstruction to the egress of his own bullet, under W. The heights of the points to which these figures refer, above the dotted line in fig. 2, are taken from the entries in column *b h*, corresponding to 800, 700, &c. yards' range.

We will suppose that A wishes to fire at B with the sight of his rifle adjusted to 550 yards. He will elevate his sash until the line of sight that joins B and the under edge of W shall cut the sloping edge of the sash, half-way between the divisions 500 and 600.

But, as on the one hand a much lower elevation of the sash than this would suffice for A's security, so, on the other hand, if this extreme elevation of 550 be adopted, A will be secure, not only against B's fire, but also against that of as many other riflemen as the nature of the "bridge" principle permits. The limits of A's security are shown by the oblique lines I I, II II, &c. (fig. 2). They are all drawn parallel to the sloping edge of S and at *vertical* distances below it, corresponding to the entries in column *a h*. They are to be used as follows:—Suppose the sash has been elevated to 500; then B's bullet, fired from 500 yards and skimming the under edge of W, will hit the sash *level* with the point where the oblique line V V cuts the vertical line drawn downwards from 500. It will be seen, on reference to fig. 2, that this level is considerably below the horizontal dotted line (which is the limit of A's security). Similarly, the intersection of IV IV with the same vertical line gives a safe level; in other words, a rifleman at 400 yards cannot hit A when the sash of the latter is adjusted to 500 yards. At III III A's danger has commenced: riflemen at 300 yards, and on the same plane as A and B, can hit him.

There is still another case. Suppose A has made his adjustment for firing at B, when he observes a rifleman, C, on a different plane to that on which B and himself are standing: what is his security against C's fire? In answer to this, he has simply to consult the oblique lines, on precisely the same principle as that already explained. He must ascertain the point at which a line of sight, passing from C and skimming the under edge of W, will cut the sloping edge of his sash. Then, if a ver-

* I should be glad to learn whether a bullet suffers deflection from passing *very* near to an obstacle, like W; and, if so, at what distance from the obstacle its influence is felt.—F. G.

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tical line, drawn downwards from that point, cuts the oblique line corresponding to the distance between C and himself *below* the dotted line, he is safe; otherwise, he is not.

Strictly speaking, in protracting these various measurements on fig. 2, allowance would have to be made for the diameter of the bullet.

If the reader will take the pains to fix a piece of paper, ruled like fig. 2, but drawn to a natural scale, against the upper sash of one of his own windows, and experimentalize on taking sights, he will find the practical application of the figure to be exceedingly simple, far more so than it would, probably, appear from the above tedious description.

Protection may be obtained at varying ranges, not only by adjusting the elevation of a sash, but equally well by adjusting that of the bridge, the sash remaining stationary; or by varying the horizontal distance between the sash and the bridge. I do not, as I have already said, propose to enter into practical illustrations of how these manœuvres may be conveniently effected; my object is simply to indicate a principle.

The way in which I have thus far put the case, does not wholly exhaust the merits of the "bridge" principle, especially when firing at short distances. I have hitherto proceeded on the supposition that A's rifle is aimed directly at B's rifle, and this would be pretty nearly the case if B were crouching in a rifle-pit or kneeling behind an embankment, exposing little more than his head to the fire of A. But if B be a soldier in the open field, that part of his person which is below the level of his rifle, when laid to his shoulder, exposes fully twelve times as large an area to the fire of A, as that part which is above it. Supposing B to kneel, the proportion will be about as 9 to 1. Consequently A need not aim at B's rifle at all. Especially at close quarters, he may elevate his sash so high as to prevent him from even seeing B's rifle, and may direct his fire at the level of B's belt, or even lower, while B would be wholly unable to see any part of A, much less to reach him with the direct fire of his bullets.

The principle of the "bridge" is just as true for cannon as for rifles; but it is another question, which I understand must be answered negatively, whether it would be possible, in practice, to construct and use such massive screens as would be required to withstand the battery of artillery.

Lastly, this principle is likely to be of greater relative advantage to us than to others, because our soldiers are the best armed of any nation; therefore their bullets have the flatter trajectories, and the value of $a\ b$ is consequently increased to their advantage and decreased to the disadvantage of their opponents. If the assailants' bullets had flatter trajectories than our own, $a\ b$ would be decreased, and might be reduced to 0, or even to a negative quantity, in which cases the bridge would be of no protection at all.

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Evening Meeting.

Monday, June 4th, 1860.

Colonel P. G. YORKE, F.R.S., in the Chair.

The Chairman announced that six Annual Subscribers had joined the Institution since the last Evening Meeting.

Nepean, Wm. Major-General	Ommanney, Octavius, Capt. Surrey Rifle Volrs.
Rodd, John R, Comr. R.N.	Close, F. A. Comr. R.N.
White, W.A. Asst. Surg. 47th Regt.	Bunn, Richd. Lieut. 37th Regt.

RIFLED ORDNANCE.

By Captain T. A. Blakely, H.P.R.A., M.R.I.A., &c.

Rifled barrels were in use more than two centuries before Mr. Robins explained the cause of their throwing bullets more accurately than smooth bores; and nearly another century elapsed before elongated projectiles were introduced, although that extraordinary man clearly pointed out the advantages to be derived from them. Progress has lately been more rapid: only thirty years elapsed between Captain Norton's first successful experiments, and the adoption in this country of his system of firing elongated bullets so constructed as to enter the barrel easily, and to expand on the ignition of the powder so as to fill the grooves of a rifle. Mr. Robins suggested elongated bullets; Captain Norton first overcame those difficulties in their use which had prevented Mr. Robins from putting into practice his own views. Hundreds, I may say thousands, have improved this system in detail; no one has yet succeeded in altering it in any material feature. The names of Robins and Norton will therefore, I venture to predict, be recorded in history long after the discoverers of the best proportions of tallow and wax for lubricating wads, and the rival advocates of male and female screw breech-plugs, have been forgotten.

The chief points on which difference of opinion still exists, are—

1st. The best method of avoiding windage, without making the loading difficult.

2nd. The proper proportion between length and thickness of projectile.

3rd. The amount of rotation necessary to keep the axis of the bullet in the desired direction.

4th. The best manner of giving the rotation.

1. The most generally-used contrivance to avoid windage is to make the leaden bullet hollow at the back, so that the gas of the burning powder shall force the edges of the lead against the inside of the rifle-barrel. It has, however, been found, that if the bullet is long the hollow is quite unnecessary, the inertia of the front of the bullet being sufficient to force

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the middle and hind parts to bulge out to the size of the barrel. Mr. Ingram, the well-known gunmaker of Glasgow (the first manufacturer in this country of steel barrels), tells me that, so far from hollowing the rear-end of his bullets, he prefers to taper them when long; and the Swiss, we know, do the same. General Jacob, Mr. Whitworth, and others, make bullets almost to fit the barrel, and by so doing are enabled to use a harder material than lead. Others again have returned to the old method of inserting the bullet at the breech-end of the rifle, which they make wider than the rest of the barrel.

Practically, none of these systems seem to have any decided advantage over the others—for small arms. The direction in which we must look for improvement is in simplification of breech-loading apparatus, or in slight alteration in the form of bullets, to permit them to enter the barrel more easily, yet to yield to the first pressure of the powder and fill the bore.

2. The length of a bullet must be determined by a consideration of the purpose to which it is to be applied. The longer and narrower a bullet is, the less will be its surface exposed to the resistance of the air; the less, consequently, the diminution of its velocity. On the other hand, it must be remembered, that the pressure of the gas of the powder acts on an equally small surface, so that initial velocity is sacrificed.

Conclusive experiments have not yet been made to ascertain the initial velocities of bullets from small-arms; but we know that the long Armstrong projectile from cannon leaves the piece with a velocity of only 1080 feet per second, and a common round iron shot with about double as much. Weighing then the facility of keeping velocity and the difficulty of acquiring it, both of which increase *pari passu* as the bullet is elongated, it will be found that, to attain any given range with a maximum of facility, the bullet must be of a particular shape. From the nature of the problem, it is clearly impossible that the best length for a bullet to range 2,000 yards can be also the best for a range of 200 yards. For the former we require a long bullet, leaving the rifle slowly, but keeping its velocity almost undiminished; for the latter we want a short bullet, to traverse the space quickly.

In deciding on the choice of a military weapon, many points must be carefully weighed. Shall the whole army have but one kind of weapon? If so, shall we sacrifice long range to efficiency at moderate range, or shall we purchase the chance of killing a general's horse a mile off at the price of ten or even five per cent. of our effective fire at close quarters? Shall we have two, or even three, kinds of rifle? These questions are yet unanswered, and, I trust, will be fully discussed this evening. My own opinion is, I confess, not the popular one. I incline to that weapon whose best shooting is at 200 yards—the Enfield rifle, or, better still, the Swiss, which fires a lighter bullet.

3. As rotation in one direction is given to the projectile to counterbalance forces tending to make it turn in another, it follows that the longer the bullet, and, consequently, the greater the leverage of the latter forces, the greater must be the correcting force. It will not, however, be enough to increase the twist in proportion to the disturbing forces, it must also be increased in the inverse ratio of the diameter of

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bullets of like length, to produce the same amount of rotary momentum. The particles at the circumference of a bullet one inch in diameter, rotating 100 times in a second, have only exactly the same velocity as those of one-half the diameter and rotating twice as often. So evident is this, that I believe no difference of opinion exists as to the rule that the more elongated the projectile the greater must be the twist.

Many experiments have been made, with a view to determine the exact length of bullet each degree of twist can steady. Amongst others, I may mention those of Mr. Dove, of Glasgow, who had a set of steel barrels rifled, of precisely the same length, weight, diameter of bore, and shape of groove; the only difference being in degree of twist. He found that, with one turn in 50 diameters, he could fire a bullet three-and-a-quarter diameters in length; with one turn in 60 diameters he could use a bullet $2\frac{3}{8}$ diameters in length, with one turn in 75 calibres the bullet might be a little more than $1\frac{3}{4}$ diameters in length.

The Swiss Government about the same time made similar experiments, and determined on the use of a military rifle, $\frac{44}{100}$ inch in bore, throwing a bullet 2·44 calibres long, with only one turn in 80 calibres. The apparent discrepancy of these results is explained by the very great charge of gunpowder used by the Swiss. Their bullets weighing less than half as much as the Enfield or Mr. Whitworth's bullets, a man can use a charge of powder which would disable him if he attempted to use it with a heavier bullet; he consequently obtains much greater initial velocity.

General Jacob made, perhaps, the most extensive series of experiments ever undertaken by an individual. He found that a bullet $2\frac{1}{2}$ calibres in length could be kept point foremost by firing it from a barrel with a twist of one in 57 calibres, even when the point was lighter than the base. While General Jacob and Mr. Dove were making experiments at their own expense, Mr. Whitworth was making some at that of the country. As he has taken out patents for any improvements he has made, they can be accurately ascertained from his published specifications, so I need only briefly refer to them. The bullet he wishes to introduce into the military service of this country is 3 calibres in length, and weighs 520 grains. With 80 grains of powder he can project this bullet from a rifle-barrel, having one turn in 46 diameters, to a distance of upwards of a mile with astonishing accuracy. The initial velocity is, however, not great, and the rifle is very expensive, depending for its accuracy on workmanship only, not on the development of any new principle. We may fairly consider it proved by General Jacob, by Mr. Dove, and by Mr. Whitworth, that with a moderate initial velocity of bullet, one turn in 45 or 50 calibres is ample to give rotation to the longest rifle bullet required. We may also accept the theory acted on by the Swiss, viz. that with greater initial velocity less turn will suffice, and the converse as proved by the Sardinians, who use a small charge of gunpowder, but the extremely short twist of one turn in 26 calibres. All the bullets I have referred to were solid, and some tapering at both ends. When the base is hollowed, and the centre of gravity thrown forward, the bullet is under different conditions, which we shall scarcely have time to discuss to-night. Suffice it to say, that less force must evidently suffice to keep the weight

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in front than elsewhere, that being the position it would seek. Captain Tamisier, a French officer, found also that circular grooves cut round the base of bullets steady their flight, by acting the part of the feathers of an arrow. He succeeded in throwing bullets, 7 diameters in length, yet point foremost. This is one of the most valuable improvements in bullets.

4. To give the necessary rotation to the bullet, grooves are, we all know, cut spirally round the inside of the rifle barrel. Some recommend shallow grooves, some deep ones; some oblong, some triangular; some recommend sharp angles, some wish the angles cut away; and, strange to say, all methods seem to answer the purpose very nearly equally well with small-arms. I will therefore reserve the discussion of this point till I come to consider the case of large guns, in which the nature of rifling will be found much more important.

Besides the main points to which I have referred, much might be said on the best method of keeping a barrel clean, on the best material of which to make it, and on many other more or less important questions, all, like the foregoing, eqally applicable to rifled small-arms and rifled cannon. I must, however, hasten to the more especial consideration of the latter.

It must have struck every one as strange that, all the conditions of success being known for rifled small-arms, cannon should not earlier have been rifled.

The reason is not obvious why large bullets from large rifles should not give results proportionate to those obtained from small bullets and small rifles. Colonel Cavalli, the able superintendent of the Sardinian cannon factory, was one of the first who grappled with the difficulty. He found, however, that if he used more than a very moderate charge of gunpowder, his cannon burst. Mr. Lancaster's experience might be stated in the same words.

In 1854 Mr. Bashley Britten made a most valuable invention. He contrived to solder a leaden ring to an iron shell so firmly that they do not separate when fired. Very many attempts had been made to surround the whole or part of iron-shot with lead, but, before Mr. Britten, none ever succeeded in making the lead adhere.

He has been engaged in a series of experiments for some years, firing his compound shells from rifled cast-iron cannon. He finds, however, that his success is limited by the certainty that the guns will burst (one has done so) if he uses a full charge of gunpowder.

In 1856 Mr. Joseph Whitworth rifled a cannon on the model of one of his successful small-arms. To a bore of only 4½ inches, he left a thickness of 9 inches of metal all round; yet this cannon burst almost immediately. He then tried one with sides still thicker, but it too burst—at the sixth round.*

In 1855 Mr. John Lawrence had a 95-cwt. gun rifled almost exactly like an Enfield rifle, and fired from it 80-pound shots, obtaining a range of 2,600 yards, with five degrees of elevation, as yet the lowest trajectory but one. The gun burst after a few rounds. I might enumerate dozens of attempts made to produce efficient rifled cannon, each with all the elements of success, except one. Windage was prevented in Mr. Britten's and in

* See Sir Howard Douglas "On Naval Gunnery."

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Fig. 1. French Gun, Pattern 1859.

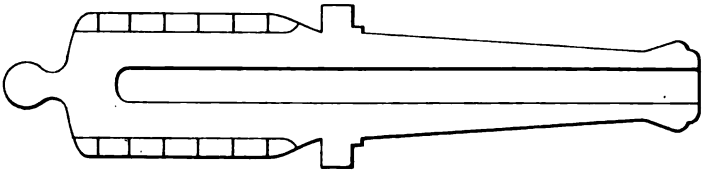


Fig. 2. Armstrong Field Gun, Pattern 1859.

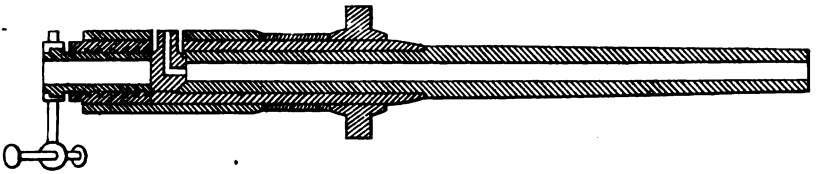


Fig. 3. Cavalli Gun, 1859.

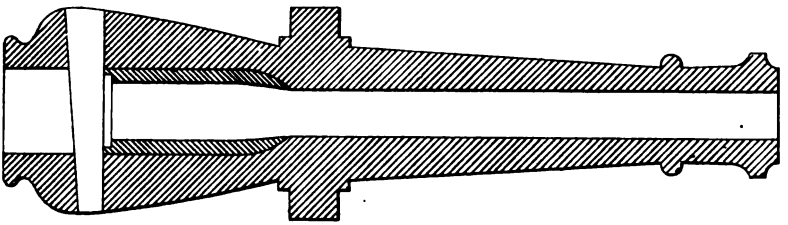


Fig. 4. 70 Pound Armstrong, 1860.

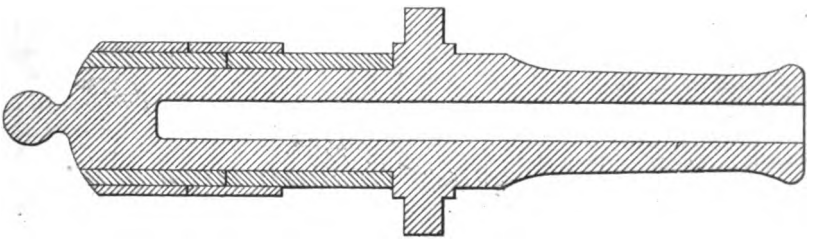
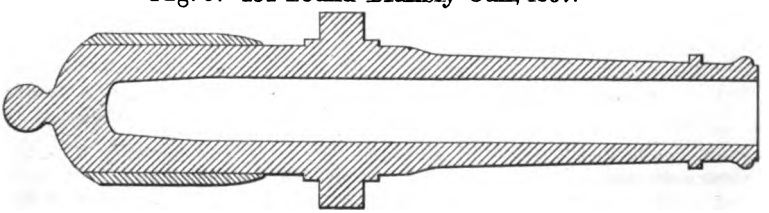


Fig. 5. 132 Pound Blakely Gun, 1857.



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Mr. Lawrence's muzzle-loading guns by the expansion of lead; in Mr. Whitworth's by the mechanical fit of the projectile. The amount of rotation adopted by Cavalli and Wahrendorff was precisely the same as that now advocated by Mr. Whitworth. Their system of breech-loading was at least as simple as his, or Sir William Armstrong's. As I said before, only *one* thing was wanting, and that was *strength* of barrel.

Now that we know how to make barrels strong enough, we are apt to forget our embarrassment a few years back—the intense disappointment with which we received the news of the bursting of Mr. Nasmyth's wrought-iron gun, followed by that of Mr. Walker's—the avidity with which Nova Scotia iron was bought up as being stronger for gun-founding—the hundreds of thousands we spent at Woolwich to discover a better method of casting iron—the cold water thrown during two consecutive years by the British Association on all proposals to build up guns—the trial of cast steel at £800 a ton—all this we are disposed to forget.

I should, however, be most ungrateful to this Institution if I allowed to be forgotten its instrumentality in diffusing the knowledge of those simple means for obtaining great strength in cannon which were first adopted immediately on their publication in our Journal, and are now almost universally used. In France, in Sardinia, and in Spain; last year in this country, and now, I am told, in Russia and in Holland, the views promulgated by this Institution have been adopted. I am vain enough to believe that experiments conducted by myself had much effect in convincing people; but, had the results of those experiments not been published by this Institution, the effect would have been lost.

The method of making cannon to which I refer is probably familiar to you all. Cannon are now made of concentric tubes, each tube compressing that within it, so that the whole thickness must take share in the strain produced by firing. I need not remind you that in any thick tube made in one piece, whether of cast iron, or wrought iron, or steel, or brass, the inside is liable to be fractured before much strain is communicated to the outside, and that it is to remedy this defect that the initial tension of the outer parts was proposed.*

I have prepared sketches of the principal cannons to which this system of manufacture has been applied. First in point of date (after the experimental cannons made by Mr. Longridge and by myself†), is the French rifled cannon (fig. 1).

It is made only in two layers, the inner of cast-iron and in one piece, the outer one of wrought iron and in seven pieces.

Fig. 2 is a section of the celebrated Armstrong gun adopted in 1859. The inner layer is made by twisting bars of iron into coils, welding each coil into a short cylinder, and then welding these cylinders together, end to end. The next layer is made by welding together lengthways two long slabs, semi-cylindrical in section; the third layer is made of coils like the first, but these are not welded to each other. I should observe, that Sir William Armstrong disclaims most distinctly any desire to obtain strength

* See Journal of United Service Institution, Vol. ii., page 304, Blakely "On a Mode of constructing Cannon," and Vol. iii., page 1, Blakely "On some Experiments elucidating his theory of manufacturing Cannon."

† See former papers as above.

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by adjusting the size of the different layers. If they do happen to be correctly proportioned he wishes it to be known that the circumstance is accidental, and that he learnt nothing from my writings.

Last year Mr. Whitworth, taught by his previous failures, and rightly attributing the success of the Armstrong gun to its strength, himself adopted the same principle of construction for his 80-pounder gun. This he made of a tube of what he calls homogeneous iron, rifled internally, and tapering slightly outside. On this conical tube he forced short tubes of wrought iron, and over these a third layer of tubes.

Fig. 3 shows a section of the gun lately introduced by Colonel Cavalli into the Sardinian service. It is nearly all of cast iron, but at the breech it has a second internal layer, composed of soft brass.

Fig. 4 shows a section of the new British Naval Gun planned by Sir William Armstrong. At the breech it is in three concentric layers, but, the outer two being avowedly shrunk on without any attention to their size, the result must be very uncertain. I can say nothing more complimentary about the shape of the interior cast iron part. It suddenly increases in thickness by five inches,—a great defect in a simple casting, much greater in one destined to be partly enveloped by a strong wrought-iron jacket. When the gun is fired the thinner part is strongly compressed and the thick part stretched. Bearing this in mind you will, I am sure, share in my astonishment, when I say that one of these cannons has absolutely been fired 63 times with proof-charge.

Fig. 5 is a section of a 10-inch gun which was made, in 1857, at my suggestion, in only two layers. It weighed less than the new naval gun, yet was fired—

10	rounds	with	20 lbs.	powder, and a projectile of	132 pounds.
10	"	"	"	264	"
10	"	"	"	396	"
9	"	"	"	512	"

I am now making several rifled cannon for experimental purposes, and I adhere very closely to the form which has given such good results. I am not aware what consideration induced Sir William Armstrong to depart from that form. They must be very grave ones, yet I trust they will be reconsidered; for I find, by experience, that a 6¾-inch gun need not weigh more than three tons, whereas his weighs five, owing to the great thickness of the middle and front parts.*

Last year I made one weighing only 48 cwt., yet strong enough to throw 58-pound shells to a distance of 2,670 yards with five degrees of elevation.† The shells I fired were on Mr. Bashley Britten's plan, than which nothing can be more simple. Figs. 6 and 7 represent these shells in section before being fired; figs. 8 and 9 after being fired, when the leaden ring *f* has

* Mr. Herbert has since acknowledged, in answer to a question put in the House of Commons by Mr. Berkeley, that these cannon are failures. At Mr. Herbert's request I am now trying to make them useful, but I fear some of their defects are incurable. —T. A. B.

† This was then the longest recorded range with five degrees of elevation. I have, however, since obtained one of 2,720 yards, with a 68-pound shell, from a 60-cwt. gun. Mr. Lawrence's shot ranged 2,600 yards with the same elevation; Mr. Whitworth's 80-pounder, 2,550; Sir Wm. Armstrong's, 2,366, and the smooth-bored 56-pounder, 2,260.—T. A. B., *Oct. 24th*, 1860.

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Fig. 6

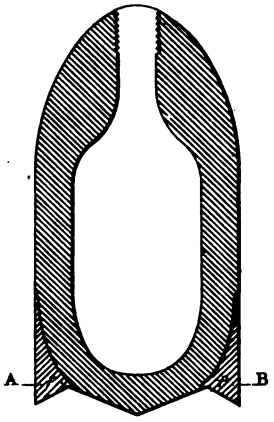


Fig. 8.

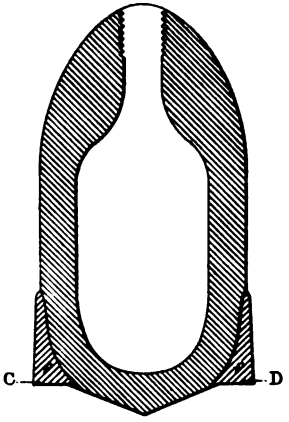


Fig. 10.

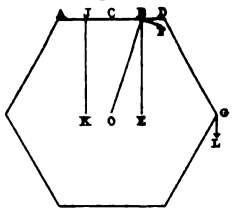


Fig. 13.

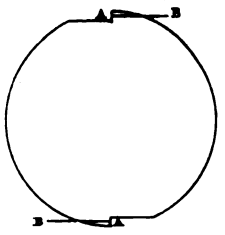


Fig. 11.

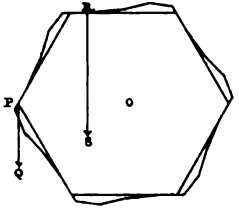


Fig. 14.

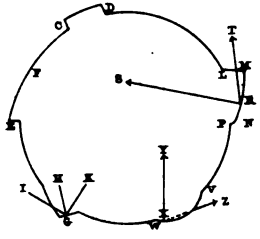
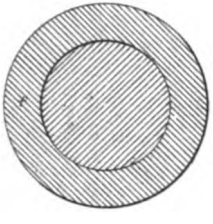
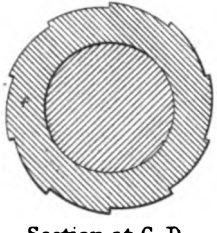


Fig. 7.



Section at A.B.

Fig. 9.



Section at C.D.

Fig. 12.

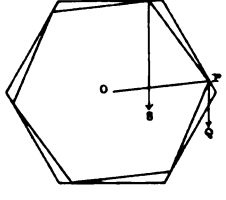


Fig. 15.

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been forced into the grooves of the gun. One of my objects in making this gun was to prove the truth of what I have stated to-night, that the efficiency of large rifled cannon depends on their being built up in concentric layers to secure *strength*. When I commenced this gun it was denied that the Armstrong cannon was made on that plan, the Whitworth 80-pounder had not been heard of, and the French model was not known to the public, so I did not anticipate having such convincing proofs at command of the efficiency of the system as I have been enabled to bring before you.

The rifling of my cannon is of the very simplest possible form. The object of rifling being to turn the projectile round its axis, it stands to reason that the best plan for applying that force is at the circumference, and in a tangential direction, as at *G*, in a direction *G L*, fig. 10.

In a hexagonal bullet the force is applied in a much less powerful manner. Such a bullet must either be too small for the gun, or too large, or else fit it accurately. The latter is the condition Mr. Whitworth first attempted to secure.

It must, however, be evident that, if the whole surface of the bullet is pressed against, one-half of every side must be pressed in a direction contrary to that desired. Thus, in Fig. 10, if the shot is meant to revolve in the direction *G L*, all the pressure on the half-side *C D* will assist this motion, all on the half-side *C A* will resist it, and cause enormous friction and waste of power. I will not dwell on the difficulty of inserting an iron projectile into a gun which it fits mechanically; Mr. Whitworth found that sometimes as much as 20 minutes was required to ram the shot home. Partly in consequence of this difficulty, and partly, perhaps, from discovering that the pressure on one-half of each surface of his shot was mischievous, Mr. Whitworth, after the bursting of his second gun in 1857, abandoned his idea of a mechanical fit, and, while retaining an almost hexagonal form for his bullet, planed away that part of the bore whose pressure would be mischievous. The bore of his latest guns is 24-sided in section, six of these sides only being bearing surfaces, see fig. 11. If from *R*, the centre of one of these bearing surfaces, a line *R S* be drawn perpendicular to the surface, it will represent the force tending to make the shot rotate. A glance will show how much less force would effect the same object if applied at *P* in a parallel direction. The most favourable condition for a hexagonal projectile will be when it is too small for the gun; then it will only bear on the edges, see fig. 12, and, the force being applied further from the centre, as at *R S*, only twice as much will be required as if it were applied at *P* in the direction *P Q*. The worst of all conditions would be the mechanical fit (fig. 10), where not only part of the pressure (*J K*) would prevent the bullet from rotating, but where the force which we may suppose to act at *B*, and to be represented by *B E*, would be so disadvantageously applied that, if we resolve it into two forces *B O* and *B F*, the former, which can only cause useless friction, will be found four times as great as the latter, which alone is useful.

It may be asked, How is it that Mr. Whitworth's small-arms give such good results, seeing that the bullets, being made of lead, are in this condition which I have ventured to call the worst possible? The reply is simple: The enormous friction, which burst the two large cannon, is useful in the small rifle, by retarding the first movement of the bullet and giving the gunpowder time to burn.

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Sir William Armstrong has found also that the resistance caused by his bullets being larger than the general bore of his guns is good for small ones, but fatal to the efficiency of his larger ones. With ten degrees of elevation his 80-pounder only ranges 3,900 yards with eleven pounds of powder. Mr. Britten can throw a 50-pound shell 3,700 yards from an old cast-iron 32-pounder rifled.

Precisely the same thing may be said of Mr. Lancaster's rifles and cannon.

In fig. 13 I have represented the section of a projectile for a large cannon. Any pressure on the surface *A* must act in the direction desired, *A B, and in no other.* There would consequently be no unnecessary friction. That very common form shown at *C D*, fig. 14, is nearly as good, but one of the surfaces, *C* or *D*, must be useless, and it surely simplifies the form to cut off the shoulder as at *E F*. The bearing surfaces must be truly radial. The slightest inclination causes increased friction, as at *G*, where the pressure, acting in the line *G H*, can be resolved into two forces, *G I* useful, and *G K* the reverse. The form of groove adopted by the French, *L M N P*, fig. 14, has all the disadvantages of the hexagonal bore, for the force is applied to the bullet by the surface *M N* in the direction *R S*, whereas motion is intended to be given in the direction *R T*.

All curved grooves, as at *V X W*, have the same defect: force is applied in a direction *X Y*, quite different from that *X Z*, in which it should be given.

Although two rifling surfaces would suffice, it will be better to have them more numerous and shallow when lead-coated projectiles are used—I find seven, each one-twentieth of an inch deep, answer well for 68-pounders. Mr. Ingram, the well-known gunmaker of Glasgow, has used the form of rifling Fig. 13 for fifteen years. I am told that Captain Hayes, of the Navy, has also tried it with success.

Although I have endeavoured to make such remarks to-night as will, I hope, lead to discussion as to the best form for large rifled cannon, I must record my decided opinion (and I trust a like opinion will be expressed by some persons more likely to be listened to) that we should not wait till a long series of experiments has decided the best form, but at once do what can be finished most quickly, viz. rifle many of our stock of cast-iron 32-pounders.

We need not even delay to strengthen them, for that can be done at a future period.

It is not to the honour of this country that it should be the last in Europe to arm its navy with rifled cannon.

The CHAIRMAN.—I will ask the Meeting to return thanks to Captain Blakely for the very interesting and instructive paper that he has just read. I believe I am correct in saying that, if Professor Barlow, of Woolwich, was the first to point out the cause of the weakness of guns and the reason of their failing, our friend Captain Blakely was the first, at any rate, to publish the proper principles for correcting that evil, and strengthening the guns. I do not pretend to any great authority on the subject, but I believe I am correct in saying so much.

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Mr. HADDAN.—It appears to me that the first and most important question is this: has it been shown that the present service guns cannot be effectually rifled? I think this has not been proved at all. Many of the trials that have been made prove nothing—it was absolutely certain the guns would burst. As a mechanic I have no hesitation in saying that no plan of rifling cast-iron guns can possibly be worse than Mr. Whitworth's. I believe that every cast-iron gun that he has rifled has burst—not only service guns, but 68-pounder blocks made of Low Moor iron, bored only to a 32-pounder bore, and they have burst with a very small charge of powder. Does not this prove that the hexagonal bore will not stand the strain? I have maintained, and I think I can prove, that that plan of rifling which leaves the bore, after it has been rifled, the nearest possible to the cylindrical form must be the best. The next worse form for cast-iron guns that could be adopted (and I am certain that no mechanic will contradict me) is the "shunting" plan of Sir William Armstrong. He has three deep, square grooves, one groove being of a different shape to the other two. It is evident that a cast-iron gun rifled on this plan would burst; and every gun he has tried, has burst after a very few rounds indeed, not only cast service guns, but guns specially cast and strengthened with wrought iron hoops. Any gentleman who will go to Woolwich can see many of these guns with the ends blown out. That being the case, the inference has been drawn by those who do not pay much attention to the subject, that the service cast-iron guns have failed, and hence the different suggestions for hooping them. Then the question is, can the present service guns be rifled so as to be available for all useful purposes? I think they can. I was present at Woolwich when one of Walker's 68-pounder cast service guns was tested. It was fired first of all 10 rounds with 16 lbs. of powder and a 68 lb. shot, then 10 rounds with 186 lb. shot, 10 rounds with 204 lb. shot, 10 rounds with 272 lb. shot, 10 rounds with 340 lb. shot, 10 rounds with 408 lb. shot, 10 rounds with 476 lb. shot, and 5 rounds with 544 lb. shot; the whole of the charges being 16 lb. of powder, and a wad was used in every case, and it burst at the sixth round with the 544 lb. shot.

That was a common service cast-iron gun, not hooped or strengthened in any way whatever. I need hardly say that no rifled shot could ever give anything like that strain. Therefore, I cannot at present see, if the guns are rifled in a way not to ruin the gun at the beginning, why the present service guns should not answer without any hooping whatever. I use a shot very much like a skittle pin. It has a conical point and a somewhat taper back. On the end or back part of the cone I use a wad of wood. The effect of the powder is to drive the wad up on to the shot, and spread it out and make it fit the bore of the gun, and the escape of gas is prevented. As to range and deflection, much depends on the weather and other circumstances. One day Mr. Whitworth may have a fine day, and he gets the best results, and he takes care to get them published. Another day may be very windy, and the results being bad, nothing is said about them. I have heard it stated that Mr. Whitworth's shots have deflected 260 yards. It is the same with others, they pick out the shots that tell, and they say nothing about those that fail. I go down alone, and Mr. Whitworth is accompanied only by friends, and each is obliged to take for granted what the other states.

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Then to come to the next point: it seems to me that the cast-iron service gun must be rifled with a very slow twist, so as to weaken the gun to the least extent. The real point is to have them rifled in a proper way; if that could be secured, then I think we should get the best results. I should wish to state one particular fact that I think will bear greatly on this question. Some little time ago I heard of Mr. Mushet, who lives at Coleford, in the Forest of Dean, and he sent me up some samples of metal, which have been tested at Woolwich, and I will read what Mr. Anderson wrote to me only last week—

"Mr. Anderson presents his compliments to Mr. Haddan, and begs to inform him that the strength of the material tested is as follows:

	Tons.	Cwt.	Qrs.	Lbs.	
1st Specimen.—	48	16	0	18	per inch.
,,	46	1	1	13	

"Royal Gun Factories, 11 May, 1860."

At the same time, Mr. Anderson gave me the results of the trial of different makes of wrought-iron which had been tested with the view of ascertaining which was the best for making the hoops for the Armstrong guns: and in no case did the wrought-iron bars stand more than 26 tons to the square inch. Now, I think, no gentleman will deem me very unreasonable in drawing the conclusion, that, if guns can be cast to bear the strain which that metal stood, it is perfectly useless to make built guns. At present I have got a few guns cast of this metal, and an application is before the War Office that one of them may be bored and tested. It is important I should state that this metal is cast and is not hammered or forged in any way, but is simply cast of the shape required. The whole secret is this, that Mr. Mushet has discovered a method of casting this peculiar metal free from honeycomb, and being free from honeycomb it does not require to be hammered to close it up. I believe guns made of this metal may be loaded to the muzzle, and cannot be burst. I will now, if you will allow me, explain my plan of rifling service guns. Theoretically, the worst plan would be to have one nick or groove, since the whole strain would be thrown on it. It would be better to have two, and three would be better still. The best plan would be to cut away as nearly as possible an equal quantity of the metal all round the bore, as the strain will then be equal. The plan I have adopted in rifling is to make three very broad shallow grooves with little or no shoulder and narrow lands, and a gun so rifled is very little weakened. Assuming that to be the case, the next question is, will a gun so rifled give the necessary rotation to the shot. The plan I have gone upon is simply this. Supposing for the sake of illustration that the bore of a gun is triangular, and that the shot is so too, but less in size, there will be no difficulty in loading. But the gun being virtually twisted by the rifling, the effect of the ball continuing in a straight line compels the three angles of the shot to bear against the three sides of the gun, and it necessarily therefore passes steadily along the gun, and with its axis in the axis of the bore, and the same effect is produced as by making the bullet expand and fill up the bore of the gun. The effect is the same in both cases, with this one great advantage in favour of my plan, that you can use a rigid bullet that does not alter its form at all, and the friction is very trifling. Of course in practice I do not make the bore triangular, but

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tri-curved, and with a shot of corresponding shape, the three curved swells on the shot bearing against the three sides of the curved cuts or broad shallow grooves in the gun. I also believe that much more accurate shooting will be thus obtained than by using an expanding ball, to say nothing of the cheapness of using a cast-iron shot, and its capability of being fired red hot, or, if made hollow, of its being filled with molten iron, the "Martin" plan, which cannot be the case with any compound shot of iron and lead. There is another result which I believe is more important than all, so far as cast-iron service guns are concerned. In my mode of rifling, the wings are at the front part, and are only a short depth along the projectile. Where the shot is rifled to the base, it is quite evident that the rifling of the gun must always be carried down to the powder, while I only carry my rifling down sufficiently to take the wings of the projectile. Consequently, I have at least a length equal to one diameter of the bore above the charge of powder unrifled. Where the rifling is taken down to the charge of powder you have the explosion taking place in or close to the rifling, and that is the reason I believe why guns so rifled have burst, and why I have had no failure.

The CHAIRMAN.—Is not the metal used by Mr. Whitworth very much of the same nature?

Mr. HADDAN.—I do not know. Mr. Whitworth makes rather a mystery of his metal. He calls it homogeneous. I believe it is tilted or hammered in some way—it is not cast—I understood he paid 100*l.* a ton for it. Mr. Mushet's metal does not cost anything like that sum.

MR. ASTON.—After the statements of the gentleman who has just sat down one would have expected to have had a little more information upon the subject. He has spoken with boldness upon what Mr. Whitworth does, but the moment any question is put as to particulars he is at fault. The metal Mr. Whitworth uses he does not give 100*l.* per ton for; and the gentleman should have heard him, at the Institution of Civil Engineers, state that he gave 60*l.* a ton for it, if his memory had not failed him. Again, I have to challenge the accuracy of that gentleman's remarks with regard to the result of Mr. Whitworth's experiments. He stated that on divers occasions projectiles that have been fired by Mr. Whitworth have gone to the extent of 250 yards, either to the right or to the left of the direction of the line of fire.

MR. HADDAN.—I heard him say so myself: in a high wind. He stated so most distinctly.

MR. ASTON.—He has also stated that this class of results had not been published, whereas Mr. Whitworth stated them in public, and they were published in "The Times" newspaper. I happened myself to have been present at Southport when nearly every shot was fired, and I saw the result of every shot published in the paper. That certainly is a new feature in gunnery, that all the shots should be published, and that the public should be left to judge for themselves. But, even supposing that in high winds shots should be thrown 250 yards to the right or left of any object aimed at, if eight or ten shots are equally thrown to that distance, is it such a difficult thing for artillerymen to make allowance for the wind, and lay the gun accordingly? Surely, if projectiles, when fired, will fall one behind the other in a moderately straight line, with a very little difference between them longitudinally, the gun that will do that will, I apprehend, be consi-

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dered a great gain, without considering the deviation, which must depend upon the direction in which the wind is blowing with regard to the range. Another thing the gentleman stated with regard to Mr. Whitworth's system of rifling, and I must say this, when I heard this gentleman state, that his is the worst system of rifling, and that some one else's was the next worst, I understood it would end in his declaring his own to be the best. That we can all understand; and when he asked us not to attribute to him any dogmatic conclusions, why, I leave that to be judged of by those who heard him. With regard to the material which Mr. Whitworth makes use of, it is called, as you know, homogeneous iron, and it is produced simply by taking the ordinary Swedish iron, which is brought over in order to be converted into steel, and melting it in the ordinary crucibles, rather larger, perhaps, than what are ordinarily used. If the ingot is for a large piece, a 32-pounder, or an 80-pounder, very many crucibles are required. The contents of all are run into one large ingot; that solid ingot is afterwards hammered under a tilt hammer to consolidate its fibres. It is afterwards bored out, and if it is a large gun it is strengthened with hoops. Now, with regard to the matter of strengthening with hoops, from the observations which fell from Captain Blakely in the course of his paper, you would suppose that Mr. Whitworth had, after communication with, or deriving information from him, made use of the system of hooping which that gentleman was the first to publish, and which he in point of fact communicated, either directly or indirectly, to Mr. Whitworth. That is a statement which I beg most directly to challenge; and I do so on the authority of a work, which is accessible to any gentleman, and to which, with your permission, Sir, I will refer. It is a book published by the Lords Commissioners of Patents, and is entitled, "Abridgments of Specifications relating to Firearms and other Weapons." In this little book are collected together short notes on the specifications of all letters patent that have been taken out relating to this subject. Of course the book will speak for itself. Those who have priority of invention are here recorded in the order in which they are entitled to claim it. I would beg, therefore, shortly to call your attention to a few of these specifications in which the subject of hooping cannon is treated. The first to which I will refer is one dated 1843. The name is John Frith; the title is "Improvements in the Manufacture of Cannon." Among other things he says,—

> The cannon is cast, and is strengthened by wrought iron or steel hoops, or rings, shrunk on while hot. The first reinforce is hooped with strong wrought iron or steel bands, driven on whilst hot, so that the contraction thereof, in cooling, will produce firm adhesion; thus that part of the cannon most acted upon by explosion and heat is materially strengthened.

The next one to which I refer is dated 1852. The names are John Linton, Arabin Simmons, and Thomas Walker. The title is "Improvements in the Manufacture of Ordnance." Among other things it says,—

> The piece of ordnance is made of wrought iron, forged solid. The mass of the piece of ordnance is formed by placing a number of segmental bars of rolled or hammered iron together round a cylindrical core, the segmental bars being twisted in the length of the faggot. The faggot is then welded together into a cylinder, which forms the core of a second cylinder, segmental bars being placed round the first cylinder to form the faggot, from which a second cylinder is made, the bars in the second being twisted in an opposite direction to those in the preceding faggot. The process of faggoting may be repeated until the mass arrives at the dimensions required for completing the piece of ordnance,

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and affording strength adequate to resist the charges employed to propel the shot under any given condition, each set of bars being twisted round the core formed of the preceding faggot in the opposite direction to that in which the bars were twisted in that faggot.

The next to which I would refer is that of William Bridges Adams, dated Nov. 20, 1854. This was a provisional specification. Probably for the information of some of my hearers, who may not know the difference, I should state that when any person applies for letters patent, he is obliged in the first instance to deposit a document which gives an outline description of his invention. That is called a provisional specification; and it being lodged in the Patent Office entitles him for six months to provisional protection. During that time he is entitled to make such additions to his invention as will enable him to carry it out more fully, always adhering to his original plan. At the end of his six months he is obliged to deposit a complete specification. This then was a provisional specification, and Mr. Adams did not think it worth while to go on, probably for reasons known to himself. He says, "My improvement consists in forming the interior of the gun of a wrought tube, hermetically joined at one end, and of as great thickness as can conveniently be attained, and casting iron, brass, or gun-metal round it, forming as far as possible a union by means of chemical fluxes." He says further, "These tubes may be hooped round with two or more rings of wrought iron hoops, shrunk on hot, and interlocking with each other." The next to which I would call your attention is that of Mr. Whitworth himself. On the 1st of December he took out a patent for "Improvements in Cannons, Guns, and Fire-Arms." He says:

My invention consists, firstly, in constructing cannons, guns, and the barrels of fire-arms in separate parts, and uniting together, by means of hoops or belts, two or more segments made of a particular shape, which when so united form a cannon, or other piece of ordnance, or the barrel of a fire-arm, the interior of which may be rifled, not by boring and cutting grooves in it, as in the ordinary mode, but by making the interior in the form of a hollow polygonal spiral or screw of the requisite pitch and number of threads. The spiral figure adopted may have any number of sides, as may be found most suitable to the size of the piece; for an ordinary rifle I have found it advantageous to employ from six to eight sides, and for a twelve pounder cannon nine sides. Great accuracy is required in making the segments, as each should be the exact counterpart of another; the surfaces of their edges intended to be brought in contact must be perfectly true, and be so shaped that the lines of junction in every case shall follow the course of the spiral, and bisect at every point one of the angles of the hollow spiral figure formed by all the segments when united. Their exterior surfaces may correspond in shape to their interior, or may be circular, so as to form when hooped together a conical surface tapering from the breech to the muzzle. The inner surfaces of the hoops or belts for uniting the segments will correspond with the outer surface of the segments on which they are fitted. The said hoops or belts may be made of any required breadth, the most economical, and may be forced on the segments so as to produce the requisite degree of tightness by a screw at the muzzle.

He also says,

A second series of belts may be used outside the others for giving additional strength.

Well, then, I say, that being so, Mr. Whitworth cannot in fairness be charged with pirating an invention which any other gentleman has patented, when the patent which he is alleged to have infringed and to have pirated from is one which is dated in the year following. If it is stated that Mr. Whitworth by using that invention infringes upon a patent of the date of 1855, it is quite clear that the patent of 1855 must be invalid, inasmuch as it contains that which Mr. Whitworth works upon under a patent of 1854. I should not at this great length have alluded to these particular instances,

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had it not been that it is a subject which has attracted a great deal of notice, and upon which most of us would be glad to have information upon which we can rely. Therefore, if what I have stated appears to bear the impression of anything like partisanship, I avow that I am an intimate friend of Mr. Whitworth, and therefore am fully acquainted with all that he has done. At the same time, by referring to the authorities I have quoted, you will be able to ascertain whether I have advanced more than I have been warranted in doing.

Mr. LONGRIDGE.—Perhaps I may be allowed to make two or three remarks upon this subject. In the first place, I must express my great regret that Mr. Whitworth's friend has thought it necessary to convert this meeting into a court of law to determine the question of priority of claims. He has referred to specifications, which, as a scientific man, I have no hesitation in saying have nothing whatever to do with the question under consideration, and which, indeed, must yield in priority to Mons Meg, and a great many other hooped guns in India. The question of priority is an unimportant question; but, as it has been mooted, I think it due to Captain Blakely to point out in what the essence of his plan consists. It is not at all in hooping guns, but it is in putting those guns together with such a degree of initial tension on the outer parts that the inner core shall be put into a state of compression. With respect to Mr. Whitworth's patent, I know that patent intimately, and I know Mr. Whitworth intimately, and he showed me himself the gun which he was making in 1855. It was in three segments; I pointed out to him then that that gun in no degree clashed with what myself and Captain Blakely were doing. The only good point about that gun was that so long as the joints between the radial segments were tight, it radiated the force on to a greater surface; and so far that was an improvement. But he found out, as I told him, that those joints would not do, and *he abandoned them*. As a scientific man, I say that that patent of Mr. Whitworth does not affect Captain Blakely's gun. With respect to the question of strengthening guns, I may briefly refer to it. The system which Captain Blakely has hitherto carried out practically is that of hoops. I refer to it because I have on two or three occasions expressed a decided objection against hoops, and it is well known that I advocate, instead of hoops, construction by means of wire. That construction is not my own idea; it is quite as much Captain Blakely's, because he contemplated the thing, too. But with respect to hoops, I think it right to state publicly that I was not prepared to find that so great an advantage could be derived from the use of hoops as is proved to be the case. The question is a purely mathematical one. It is not a matter of opinion, but is as much a matter of demonstration as the laws which hold the planets in their courses. It is shown most clearly that if you have a cast-iron gun of six inches calibre, and the gun itself is six inches thick, and you put on to that a ring of wrought iron three inches thick, with the proper degree of tension you make the resisting power of that gun more than double; that is to say, if it would bear a pressure of four tons to the square inch inside before you hoop it, it will bear nine and a quarter tons after you hoop it. I was not prepared myself for so great an increase; and, having expressed a decided opinion against hooping, I think it right when I find myself wrong to recant that opinion, and to state that the advantage we derive from it is

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very much greater than we expected. At the same time, I must state that if instead of that three inches of wrought iron you put on one inch of wire, you will get exactly the same result. I advocate wire because you can lay it on with a tension which is perfectly known to you from beginning to end, whereas the tension with which you put on wrought iron is, more or less, unknown to you. *It is in that tension that the whole secret of strengthening guns consists.* It is here that Sir William Armstrong and Mr. Whitworth are acting contrary to the law which mathematical demonstration points out. Mr. Whitworth is putting on hoops with as great an initial tension as the iron will bear without injury. He puts it on until it is just on the point of a permanent set; consequently, the least more force will give it a permanent set, and will alter the condition of that gun.* I told him he was putting on his hoops in error, without due regard to mathematical tension. Captain Blakely has always put them on with due consideration to that point, and that is one secret of the success which his guns have attained.

I quite agree with Captain Blakely in what he stated with regard to the difference in methods of rifling. There can be no doubt about it. The force which is to give rotation to the shot should be applied to a surface so situated that the whole force shall be in the direction in which motion is intended to be given. That is the practical principle on which rifling should be carried out. The pressure then must come at right angles to the radius. In the hexagon the pressure must be exerted at right angles to the surface of the hexagon. Consequently, if we suppose the pressure is on *B* (fig. 10), that pressure can act only in the direction *B*, *E*, perpendicularly to the surface, whereas to give rotation the pressure should be in the direction *B*, *F*, at right angles to the radius *B*, *O*. In the case of Mr. Whitworth's gun, supposing the whole pressure was exerted at the angle *R*, fig. 12, which is the most advantageous point in his system of rifling, it would exactly double the normal force exerted on the gun. If it was exerted at a point two-thirds down it would treble it. The result of that is very much to increase friction. I mention this because, in a paper which I read at the Institution of Civil Engineers, I stated that in the case of Mr. Whitworth's 80-pounder gun, the amount of friction which was generated on account of the rapidity of the twist, did not amount to more than 3,000 lbs. I meant to say that, not with reference to the particular system of rifling adopted by Mr. Whitworth, but with the most advantageous system of rifling, that the friction *necessary* to give rotation would amount to 2,012 lbs. It is very evident that that was the meaning. Still it was misapprehended; therefore I think it right to explain it.

With respect to the weakening of the gun, alleged as a defect of Captain Blakely's rifling, it has no such effect at all. The depth of the grove is one-sixteenth of an inch, and the fact is, we depend in these hooped guns for the strength entirely upon the material which comes outside the cast iron. The cast iron itself is very little strained, so little, indeed, that in a gun of six inches thickness, when the outer portion is strained with a tensile force of four tons to the square inch, the inside layer would be in a state of compression, consequently so small a re-entry angle has no effect whatever in weakening the gun. If sufficiently strengthened on the outside there is no danger of these rifled guns bursting from any cause of this sort. The real cause of rifles bursting is, that the *inertia* of the shot and the

* Mr. Whitworth's 80-pounder has since cracked.—J. A. B.

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decrease of windage is so different from the conditions of the round shot, that the pressure accumulates behind the ball to an extent which it never had before. With a round shot the pressure accumulates to four tons to the square inch, and the shot acts like a valve, and moves away. But with these long shots the pressure accumulates to fifteen or sixteen tons to the square inch, and it can easily be seen that no cast iron, not strengthened outside, can bear more than five or six tons to the square inch; therefore guns burst under these circumstances. It is perfectly impossible for cast iron to bear more than the tensile force of the material inside. All these experiments which have been made have been made in perfect good faith, but I say in a scientific point of view they do not bear upon the subject at all. I hope the Government will take up the subject as it was done in the days of Dr. Hutton; that they will employ a man with Dr. Hutton's knowledge, perseverance, and care, and will put at his command the appliances of the present day, and that they will institute a series of experiments with the present rifled guns, in connection with the ballistic pendulum. If they will do that, I am sure they will put gunnery upon a different footing from what it is now, and we shall not have to go down to Shoeburyness to fire shots of all sorts, and get the most contradictory reports of them, and from those contradictory reports be called upon to express our opinion upon the construction of guns.

Captain F. C. Simons, late Bengal Artillery.—I wish to make a few remarks upon the different figures of rifling. My own impression is, that one field rifle is practically as good as another. But I prefer the old systems to those which have been more recently introduced, and I think the old multi-grooved system of rifling is as good as any known at this day. Perhaps that system which Captain Blakely has indicated, the cog-wheel, is quite as good as any other; in fact, I think it is the best system of rifling which has been brought to notice. But I feel quite persuaded that most excellent cannon can be made, let the figure of rifling be what it may. Though I do not think Mr. Whitworth's system of hexagon, or Mr. Lancaster's oval, or indeed any of the smooth-bored systems, are as good as others, yet I think practically they will be found to answer perfectly well. The reason why I think the smooth-bored system is not so good as others is, because the leverage belonging to them is less. You are all familiar with the action of a capstan when an anchor is weighed. You may put as many levers into that capstan as you like, still the sensibility of the capstan will not be increased. One long lever will raise an anchor much more easily than a hundred short levers, with the same power applied, distributed over them all. To apply that to the case of gunnery, I would say that when a cannon shot is fired two motions have to be given to it: one the forward motion, the other the rotatory motion, and the longer the lever you put into the projectile to produce rotatory motion, though that lever be only one, the more sensible will be the projectile, and the more easily will it come out of the bore. With respect to the hexagonal system, I would say the hexagonal bullet is turned by pressure on half of its six sides. It must be quite evident, that if the pressure were equally distributed on the six sides of the hexagon, the ball could not be made to turn at all; it is by pressure applied on half of each side, acting as six short levers, each as long as half a side of the hexagon at *O*, *T*, fig. 11, that the hexagonal bullet is made to turn. That which makes the oval bullet turn is pressure

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upon its two foci; but the pressure upon one focus counteracts to some extent the pressure on the other, and the consequence is that the oval rifle makes its ball turn by a pressure applied to the end of two short levers, situated between the centre of the oval and the foci. Now, in the old system of rifling, the pressure is applied at the end of the whole radius of the circle, and the consequence is, that the balls are what mathematicians term much more sensible. It is as if you were to put a long lever into a capstan instead of a short one. Consequently, the forward motion of the ball as it passes out of the bore is not so much retarded. With respect to the smooth bore system I may further say, I consider the same initial velocity may be given out of one bore as out of another in many instances. Perhaps, in cannon, it may not be the case; but I have reason to believe it is the case with respect to small arms. From what I have heard of the experiments made with Mr. Whitworth's small arms, the superior *inertia* of the bullets fired out of the smooth bore increases the strength of the igniting powder behind it. At one time, it was thought the powder ignited instantaneously; but it is not thought so in the present day. Still, as bullets fired out of bores, where the pressure is applied at the end of the radius instead of near the centre of the circle, come out more easily, and the powder does not come out so strong, therefore I think that the guns are less likely to burst. There is another point I beg to be allowed to advert to. I have heard it stated, that if a ball be fired out of a rifle it will have a tendency to deviate in the direction of the turn. My own impression is, that it has no such tendency at all, but just in the opposite direction, that is to say, if a right-handed spin be given to a ball its tendency will be to deviate to the left. I do not mean to say that such deviation is of any importance, but, so far as it does exist, it tends to deviate to the left. The reason of it is this, that, the air acting upon the wings of the bullet, as the ball passes forward, in consequence of the hinder end of the ball becoming tilted up, it acts with greater force on the under part of the projectile than it does on the upper. I may also say, with respect to the strength of cannon, that Mr. Whitworth's cannon is proved to be perfectly durable. Of course, if they can be made cheaper, as Captain Blakely has suggested, by his system, so much the better; but the great thing is to have strong cannon. It is not fair to artillerymen to give them cannon that will burst. It must be much worse for artillerymen to have guns burst around them than to have shots thrown at them by an enemy. There is another point with respect to these figures of rifling. If a number of air guns were made and rifled with a different degree of turn, and grooves of different figures, and fired at planks, it would then be ascertained by such means whether the forward velocity of the projectile is really more retarded in consequence of certain forms of grooving being adopted. Each should be fired with a given weight of air of a given degree of condensation, as measured by the number of strokes given to the piston by the air-pump. This would get rid of that uncertain ingredient in the calculation, the varying strength given out by gunpowder. I may say, that I consider myself to be the inventor of the Whitworth cannon. In the year 1858, when in India, I published a book in which I recommended that a gun, with a breech screwing on, and not in, should be made, and that a greased wad should be forced in as often as necessary, to keep the bore clean. The object of this breech-opening appa-

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ratus was solely with the view of keeping the bore clean. Loading at the breech I do not consider at all necessary for any other purpose. I do not pretend that I recommended the peculiar cartridges which Mr. Whitworth uses, nor his breech-loading contrivance; nor do I wish to detract from the great merit of an enterprising gentleman like Mr. Whitworth. Still I do say this, that in 1858 I recommended a cannon, with a breech screwing on, and not in; and a book in which I mentioned this I sent to Mr. Whitworth in March, 1859. Mr. Whitworth did not take out a provisional protection for that patent till the 30th of August, 1859. I may further say that, two or three years ago, Mr. Whitworth did take out a patent, in which he had a breech screwing on, but it was so regulated to run back that it nearly ran off the gun. It was made with a totally different object in view from that which Mr. Whitworth has with the present breech. I may conclude by saying, that those who really desire to know my opinions will find them in a series of letters which I have written in the last four or five numbers of the "Mechanics' Magazine."

Mr. Bashley Britten.—As I wish to be very particular in the statements I make, and to give with accuracy the results I have obtained, more particularly with cast-iron guns, and to point out what I think is a matter of extreme importance, that it is possible to rifle the present iron guns without even hooping them, I have prepared a few remarks, which I will read:—

As my name has been several times alluded to in the course of the evening, not only in reference to the projectiles which Captain Blakely has employed in his recent experiments, but also with regard to the efforts I have made to improve the old guns now in Her Majesty's service by rifling them, I may be permitted to make a few observations.

Six years ago, when I directed my attention to this subject, it appeared to me that improvements in artillery were to be brought about most readily by introducing a better kind of projectile than had hitherto been used. It was obvious that the first thing to be done was to devise some plan for adapting the principle of the rifle to cannon, and it was a very natural thing at the time to look at the Minié bullet for instruction as to the means to be adopted for accomplishing this. The difficulty that at once presented itself was the necessity for devising some plan for uniting a soft metal, like lead, to iron in such a manner as to withstand the shock of discharge from a rifled gun. After some time I found out how this might easily be accomplished, and a projectile formed possessing all the essential qualities of an expanding Minié or Enfield bullet, while the quantity of lead, which is an expensive material for cannon balls, was reduced to a minimum.

We were then at war, and we had a vast number of guns on board our fleet, and in the trenches before Sebastopol, which were positively useless because of their limited efficiency. I saw, or thought I saw, that I had hit upon a plan for improving those guns, and rendering them serviceable. I communicated with the authorities, and entreated for an opportunity of shewing the value of my scheme, but this was at once refused. Sanguine of success, I again applied to the War Office, and consented to bear the expense of such experiments as would be sufficient to establish the correctness of the principle of my invention. I obtained permission to do this,* and, in

* The first experiments were made in the early part of 1855, and the correctness of the

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the course of trials made with a rifled 9-pounder cast-iron service gun, in the months of March, May, and July, 1855, results were obtained which led to my being informed officially that further trials would be made with my scheme at the Government expense. With this 9-pounder gun, throwing shells of 14 lbs. weight, with 1¾ lbs. of powder, I obtained at this time a range of 3,200 yards, at 10 degrees elevation, which was 1,000 yards beyond the usual range of such guns with smooth bores, and equal to the range of Sir William Armstrong's 12-pounder gun which, four years after, has been adopted in the service. The shells I then used are in all respects similar to those I have since employed. My proposition was then the same as it is still, viz.:—

Let any or all of the guns in Her Majesty's service be rifled with shallow groves, which would not weaken the guns, and would not at all interfere with the use of the common round shot, but employ also projectiles like those which have been described to-night, with which so great a degree of superior efficiency may be obtained.

I did not propose to substitute other guns for those we had in use, because it was sufficiently obvious that the expense of doing this would be enormous, and that if I could do so much better than had been done before with the guns we had, this surely would be a national boon, and it would naturally follow that when stronger guns than our old ones should be constructed, still greater proportionate results could be obtained with heavier charges and heavier shot than it would be safe to employ with the guns we had then in use. At that time there was not so much known about this subject as there is now; there was only the Lancaster gun under trial: nor was the actual strength of the cast-iron guns so well known. The task I undertook was, therefore, not an easy one, for I had not only to determine the rifling suitable for projectiles like mine, but I had also to adapt the weight of my projectiles and the charges of powder to the

principle of the invention was then fully established. The following guns have now been tried under official superintendence. Up to the present time (December 1860) there have been fired from the unstrengthened Rifled Service guns—.

				About.
From the	2—9-pounder Rifled Guns,	54	rounds of Shells,	14½ lbs.
,,	1—32 ditto (rifled in 1856),	300	,, ,,	48 ,,
,,	1—32 ditto (rifled in 1860),	300	,, ,,	48 ,,
,,	1—68 ditto (rifled in 1860),	300	,, ,,	90 ,,

Four other guns, rifled in 1860, have been subjected to another trial of a severe character, with a view to test their strength as Rifled Guns:—

From each of 2 Rifled 32-pounder Service Guns, 58 cwt. each—
10 Rounds, with proposed Shells of 48 lbs. each.
10 Rounds, with heavier Shells, on same principle, 72 lbs. each.
10 Rounds, with solid Shot, on same principle, 96 lbs. each.

From each of 2 Rifled 68-pounder Service Guns, 95 cwt. each—
10 Rounds, with proposed Shells of 90 lbs. each.
10 Rounds, with heavier Shells, on same principle, 135 lbs. each.
10 Rounds, with solid Shot, on same principle, 180 lbs. each.

The main object of all these experiments has been to ascertain whether the cast-iron guns are strong enough to be converted into rifled guns on my system, without undergoing any process of strengthening. The result has been that in no instance has any Service Gun burst or apparently suffered injury, to which this system has been applied.—B. B.

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strength of the guns. A single mistake, involving the bursting of a gun, I knew would be fatal to my efforts.

The repeated failures of the Lancaster gun, involving sacrifice of the enormous sums of public money which were lavished on that system, induced the belief that cast-iron guns were not strong enough to be rifled; but the fact that whenever the Lancaster guns burst, it was always in front of the trunnions, while guns which burst under proof charges always go in rear of them, was a clear proof to my mind that the cause of bursting was not the charge of powder, or the weight of the projectile, but was connected with the method of rifling, and the employment of a rigid shot, at any time liable to get jammed in the gun.

I avoided this danger entirely by the employment of lead, which would give way before the rifling could produce any excessive strain on the gun. I also employed grooves, which weakened the gun much less, and likewise made use of a spiral of considerably less twist.

Now, although during the years 1856, 1857, and 1858, I was constantly importuning the authorities for leave to continue my experiments, very little was done till the following year. On reviewing what had been done, it was then considered that my proposal had not been sufficiently disproved. I was consequently desired to make another trial with the 32-pounder gun which had been rifled for me in 1856, from which I had been only allowed to fire seven rounds. This further experiment produced results which seemed to throw new light upon the question. Since then many other experiments have been made, which have all tended to confirm the view expressed by me originally. I will now explain, as briefly as I can, what these experiments have been.

The service guns which I have used, with nothing done to them but planing out the grooves, with the charges of powder and weight of projectiles, will be seen below.

RIFLED CAST-IRON SERVICE GUNS UNSTRENGTHENED.

	Cwt.	Charges.	Weight of Projectiles.	No. of Rounds.
9-pounder ..	17 ..	1¼ to 2¼ lbs. ..	13 to 15 lbs. ..	24
9-pounder ..	17 (No. 2)	1½ to 2 „ ..	15 to 16 „ ..	30
32-pounder ..	56 ..	5½ to 6½ „ ..	48 to 51 „ ..	75
32-pounder ..	58 (No. 2)	5 to 6 „ ..	48 to 51 „ ..	176
68-pounder ..	95 ..	6 to 8 „ ..	88 to 100 „ ..	130

The above are all the service guns which have been tried on my system, and not one has yet burst, or shown any sign of injury. They have not burst simply, I suppose, because I have not overloaded them. Any gun will burst if overloaded, but why should rifled guns be overloaded beyond their strength? I know not what is meant by the expression, "Our old guns are not strong enough to be rifled." This question has been much embarrassed by the heedless manner in which different inventors of rifled ordnance have charged their guns. Elongated shot can, of course, be made of almost any weight; and these heavy shot in rifled guns have the power of converting a given quantity of gunpowder into a far more powerful agent than any round shot could do. The mere prevention of windage will render 10 lbs. of powder equal to a charge of at least 15 lbs. where there is windage to any extent. The consequence has been, that many cast-iron

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rifled guns have been loaded beyond their strength, and have necessarily failed, and the cause has been assigned to the uncertainty of the metal rather than to the severe conditions under which it was tried. In order to show that excellent results may be obtained from rifled service guns without employing excessive charges, I will now state the results of a few of my experiments.

My guns have all been fired under the ordinary conditions, no kind of lubrication has been used, and no attempt made to adjust the trunnions horizontally, or any other refinement; and in the particulars I am going to give I have not made any selection of good shots.

In February last year, I fired from one of my 32-pounders eighteen shells 48 lbs. each with 6 lb. charges. At 10° elevation the average range was 3,450 yards, and the average deviation right or left of the line of aim was 5 yards. In March, 1859, ten rounds of similar shells with the same charge and the same elevation gave an average range of 3,490 yards, deviation right or left 6 yards. Now this may be compared with six-pound service shot fired in May last year, by way of comparison, from a 32-pounder smooth-bored gun with the service charge of 10 lbs. of powder, when the range obtained at 10⅜° averaged only 2,738 yards, and at this distance the mean deviation right and left exceeded 25 yards. In November last year, twenty-five rounds fired from my rifled 32-pounder with 5 lb. charges at 5° elevation, gave an average of 1,845 yards, with 2 yards lateral deviation, and on the same day twenty-five rounds more at 10° with the same charge averaged 3,111 yards with but 4 yards deviation from line of aim. In January last, twenty rounds at 5° with 5 lbs. charge went 1,831 yards with a deviation of 3½ yards, and twenty-four rounds at 10°, 3,263 yards with 4⅜ yards deviation.

With these small charges the recoil of the guns is invariably less than with similar guns smooth-bored on the same platform fired with the service-charges, and, as recoil must be an indication of comparative strain from within, there can be no reason for the belief that the rifled guns were at all overtasked. With these facts before me, how can I receive any person's dogma as to the impracticability of improving our stock of guns?

It is then to these facts I appeal when I ask the Government to proceed with the investigation of this important question, and not to decide too hastily about condemning our vast stock of ordnance. It will be seen that the benefits to be derived from the rifled ordnance are not simply greater range and superior accuracy, but it also consists in the greater weight of metal thrown and the more destructive nature of the projectile. I will state this more clearly by giving the following summary of advantages:

1. My plan can be applied at once to the iron and brass guns now in Her Majesty's service. To rifle the present guns is a very simple operation, which may be performed with portable machinery worked by hand labour, either on board ship or elsewhere.

2. When so altered, the guns will be capable of discharging projectiles more than half as heavy again as the present solid shot for the same guns, and of a far more destructive character.

3. The new projectiles for the altered guns will not only have greater force and penetration, but they will have an effective range exceeding by several hundred yards that of the present solid shot.

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4. The altered guns will command greater accuracy up to 4,000 yards, than the present guns have at 2,000 yards range.

5. The new projectiles, besides having the advantage of greater weight, length of range, and accuracy than the service solid shot, are explosive shells. These shells will hold three times as much powder as the service shells for the same guns, and they can be fired so as to explode at any distance, or only at the moment of striking.

6. Shrapnel shells on the same principle will hold more than three times as many bullets as the common Shrapnel for the same guns, and have a longer sustained velocity.

7. The present guns, when rifled on proposed plan, can still be used as effectively for round or case shot.

8. My projectiles can be made for so little cost beyond that of the common shells, that the saving of powder effected in the requisite charge for the gun would be an equivalent.

9. By strengthening the present service guns in a manner which has been tried and proved effectual, the above advantages may be further increased, and results obtained equal to, if not surpassing, anything yet accomplished with the recently adopted breech-loading rifled cannon, which are of the most elaborate and expensive construction.

The last point here mentioned I have not yet adverted to. Before doing so, I would ask whether these combined advantages to be derived from the old guns by merely rifling them (and this could be done for about 30*s.* each) does not really amount to more than doubling their present efficiency, and is not this worth gaining? I say then let any or all of our guns be rifled without loss of time, and let such charges of powder and such projectiles be used as conclusive trials may prove they will safely bear. We know not how soon we may want them; therefore, why should time be lost? There is no necessity for resting content with this. Those guns when so rifled may be made to do far more work still. As leisure serves, they might have wrought-iron or steel hoops placed round them from the trunnions to the breech, and this would render them as good as any guns which, in my opinion, could be made of any material or at any cost. How far Capt. Blakely may be entitled to claim this plan as his own, I am not called upon to express any opinion, but I do believe he has done far more than any one else to show how far this may be effected, and it certainly appears to me, that what he has done, has not been fairly acknowledged.

Besides the service guns which I have before spoken of, two other guns have been rifled on my system. They are cast-iron guns, with a greater thickness of metal. I have experimented with them in such a manner as to show as far as I could with them the better results which might be obtained from our guns when rifled and strengthened with hoops. One of these guns has the bore of a 32-pounder, the other that of an 18-pounder. From the 32-pounder I have fired 100 rounds of shells of 58 lbs. each, and about 7 lb. charges, with the following degree of accuracy:

No. of Rounds.	Average Range. Yards.	Deviation right or left. Yards.	Feet.
21	952	0	2¾
21	1,937	1	1¾
21	2,485	2	1¼
21	3,264	3	1
16	3,612	3	1¼

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From the 18-pounder, which had an extra three-quarters of an inch in thickness of cast-iron beyond the service-pattern—and this gave little additional strength to the gun, I have fired shells weighing 34 lbs. with charges of 6½ lbs. of powder, and obtained the following results:

No. of Rounds.	Average Range. Yards.	Deviation right or left. Yards.	Feet.
21	1,110	1	1
5	2,080	1	1¼
8	3,750	2	2

This gun, which had never been subjected to the usual proof in order to test the soundness of the metal, unfortunately burst. The strain to which it was subjected by the above charge, although greater than it would be safe to employ with ordinary cast-iron guns, is not nearly so great as the system of hooping would supply.

The above range of 3,750 yards with 34-lb. shells, which was at an elevation of 10 degrees, is somewhat greater than that of Sir William Armstrong's 32-pounder breech-loading wrought-iron gun; and considering that the above practice took place with the wind blowing across the range with the registered force of 6 to 7, which is really a gale of wind, the deviations are remarkably small. Any greater degree of accuracy than this would certainly be valueless. My belief is, that there is not a gun in the service which might not be made to do as well or even better than this gun, by rendering it strong with bands of good iron round the breech. For my own part I desire to have no better guns than hooped service guns for showing the utmost that can be done with my system of rifled cannon. From inquiries I have made, I am satisfied that the cost of thus strengthening our guns should not exceed a fourth of their original cost; why, therefore, this important point has been so coldly treated, while such strenuous efforts have been made to hasten the manufacture of other guns, more costly in material and far more elaborate in construction, is a question which I am unable to solve. I have seen an instance in which a wrought-iron band more than an inch-and-a-half thick was shrunk upon the breech of a cast-iron gun, where the metal was more than six inches thick, and, when the gun was proved with a very heavy charge, the wrought-iron band was broken, and the cast-iron gun remained sound. No clearer proof can be given that good cast-iron is sufficiently elastic to transmit the strain from the inner to the outer circumference of cylinders of this thickness, and on the outer circumference wrought-iron or steel bands may be put of any degree of strength.

Mr. Lawrence.—The reason I wish to speak upon this subject is because Captain Blakely in his paper gave me credit for producing the second-best gun. The principle on which that gun was made is precisely the same as that explained by the gentleman who spoke immediately after Captain Blakely [Mr. Hadden], viz. that of making wide and shallow grooves, and giving a very considerable twist to those grooves. The question of priority has been alluded to, and I cannot help thinking it has been spoken of rather lightly, because, when a thing has once been done, surely there can be no great merit in following in the footsteps of the first

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person. The party who opens the way for others must surely possess a greater merit than those who merely follow in his footsteps. Mr. Bashley Britten has claimed to produce very considerable results, but those which I have obtained still possess a great superiority. I obtained at an elevation of 5 degrees a range of 2,595 yards; at an elevation of 10 degrees a range of 4,000 yards; and, at an elevation of 28 degrees, a range of 7,300 yards; and this with solid shot of 80 lb. We have to consider—not the easiest and cheapest mode of making guns, but the sort of guns we should most likely have to contend with. We ought to have looked at the results the French have produced, which the Russians have attained, and also the Americans. These are the three powers, that, if we quarrelled at all, we should most likely quarrel with. It is clear to me that the gun which Captain Blakely has stated to be on the French system is a much more powerful one than the one we have, obliged as we are to reduce the charge of powder in order to allow for the weakness of the gun. We ought to have a gun in which we could put the greatest charge of powder that would be necessary to project our shot. It is no use putting too much powder, because you do not produce greater results by that means, but you ought to have a gun sufficiently strong to bear the greatest amount of powder that is requisite to project a shot the greatest distance. My original attempt at invention was with a bullet in 1852. I then made a cannon-shot on the same principle; but on trying it I found that that was only half the invention; that the gun required improving precisely as much as the shot itself. It was a considerable period before I could adopt the principles which I found would obtain the best results—not until 1855. At that time I had the authority of the Government for making an eighty-pounder gun. It weighed 95 cwt. and was what is ordinarily understood as a sixty-eight pounder. From previous experiments, I felt convinced that it was requisite some additional strength should be given to that gun; and I therefore suggested that, instead of the gun being bored to the whole extent—eight inches, it should be reduced to six and three-eighth inches, which gave of course greater strength to the gun. The rifling I recommended to be reduced from two-tenths of an inch, which was the original form given by the authorities at Woolwich, to one-tenth in the centre of the groove. That was tried, and the gun constructed on that form was made, I believe, at Low Moor. It was certainly rifled at Woolwich, and was tried at Shoeburyness in May 1856. I never saw the gun till it was fired, nor do I believe the officer did who fired it. Nineteen shots were fired from that gun at various elevations, from point-blank range up to ten degrees. The extreme range was 4,125 yards. The charges used were various—from 12 lb. up to 16 lb., and the accuracy was such that twelve out of those nineteen shots only varied from the right line one yard and one-fourteenth. One of the shots reached upwards of 4,000 yards, and was just three yards out of the straight line. Notwithstanding those results, I was not allowed to continue the experiments with that gun; and it was not till three years and a-half afterwards that I was able to take another step. On that occasion the gun was fired at ten degrees and at twenty-seven degrees. At ten degrees it produced similar results to those on the previous occasion—it ranged 4,000 yards. At twenty-seven degrees it ranged 7,900 yards. There was one peculiarity in the greater range, that the shots fell

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close together. Only forty-eight yards on the average was the difference in 7,000 yards, and the time of flight was thirty seconds. That gun was subsequently tried for penetration, and, as Captain Blakely told you, it burst. But the reason of its bursting was this. On every occasion, from the first, I pointed out the necessity of lubricating expansive cannon-shot. I had used grease. On the last occasion no grease was used; consequently, the expansion of the shot not being eased by the use of any lubrication, the shots, I suppose, blocked and burst the gun. I have fired nine-pounders, and cannon of other calibres, and have had no accident whatever. I therefore attribute the bursting of that gun to the absence of grease; every other person when he fires rifled cannon-shot uses grease. I believe Mr. Whitworth is most particular in the use of that substance.

Mr. BRITTEN.—I use no grease, nor anything of the kind.

Mr. HADDAN.—I use no grease. Might I ask one question? When you talk of extreme range, do you mean the range with the first graze?

Mr. LAWRENCE.—The first graze decidedly. In speaking of these experiments, I quote from official documents. I have never made an experiment myself; they have always been made at Woolwich or Shoeburyness. I should like to explain the nature of my shot, which is entirely different from that of any other gentleman. The forepart is made of zinc, and the hinder part of lead. The weight of the shot is 32 lb. or 68 lb. The length of the shot is 8⅜ inches. The effect of using zinc and lead in that manner is this: when the bullet strikes against an object the zinc does not give way, but the lead does, and it takes from the force of the shot, just as a person in jumping from a height bends himself—he does not feel the effect of the fall. This was proved to be beneficial by firing against sand, against 14-inch oak, and against granite. Therefore, it is not a mere theoretical advantage, but it has actually been proved in practice. The object in making shot about 1½ diameter instead of a long shot, is that you get a better second graze in a direct line, while with all the long shots you cannot depend upon where your shot gets the second graze; it will go to the right or the left. Another advantage which I get from using that kind of shot is, the certainty of a perfect joint which time will not affect. In all shots which are made of iron connected with lead, time must certainly have an effect upon the goodness of the joint. It would be impossible to make shot fresh and fresh; you must have some in store, and the result will be this: that when you come to use them after a considerable time your shots will be found in many cases unserviceable. Another point is this: there have not been sufficient experiments with large shot of that description, to ascertain whether you can make a perfect joint in them. With light shot you can; but I have much doubt whether with large shots a perfect joint can be made.

Mr. HADDAN.—As the gentleman who is the friend of Mr. Whitworth, and knows all that has taken place, is about to leave the room, I would ask him whether the 80-pounder gun tried at Southport, two or three weeks ago, did not blow the breech off?

Mr. ASTON.—All I can say is, that the 80-pounder which was fired at Southport the other day sent every shot——

Mr. HADDAN.—(Interrupting.) That is no answer to my question.

Mr. ASTON.—All I can say is, that when I was at Southport I saw certain results, and when I was at Shoeburyness I saw certain results.

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CAPTAIN BLAKELY.—I will trespass a very short time on your patience. I would merely remark, that the great success, both of the Lancaster and Whitworth small arm, must not make one suppose that the system is equally good for cannon. In a small rifle great friction gives time for the powder to burn, and the power is accumulated behind the shot. Now, the great weight of the large shot is quite sufficient to give full time for this. No unnecessary friction is required. In a large gun, therefore, I think we should rather ease than impede the passage of the shot.

Mr. Aston has read us portions of Mr. Whitworth's specification, with a view to show that he patented in 1854 the plan of constructing cannon which I advocate; and Mr. James Longridge has told us that he on the contrary pledges his reputation that Mr. Whitworth's specification contains no description of any plan similar to mine. Luckily Mr. Aston has Mr. Whitworth's specification here to refer to and settle this question; and if he will permit me I will read the sentence in it immediately following those he read—

When it is important that the weight in a small cannon or fire-arm should be diminished, instead of constructing them in segments as above described, I find it more convenient to make the tubular part in one piece.

I cannot think how this can have escaped Mr. Aston's attention, proving as it does that Mr. Whitworth believed a tube made in one piece to be stronger than one made according to his own patent, viz., of longitudinal staves hooped together. Some may think that Mr. Whitworth meant to hoop the tubes made in one piece, but such cannot have been his intention, for he goes on to say that he makes these tubes taper from breech to muzzle, and casts the trunnions on. A glance at a sketch of a gun thus formed (fig. 15) will convince any one that hoops cannot be put on, except from the muzzle to the trunnions. I had better read his own words, and let you compare them with my sketch. He says:—

I make the exterior to taper from the breech to the muzzle, either of the ordinary conical figure, or of a spiral angular figure corresponding with the figure of the interior, so that in any transverse section there is uniformity of thickness and strength of metal. In the case of cannons so constructed, the trunnions are cast on.

It is therefore clear that he meant to leave these guns unhooped. Why, then, did Mr. Whitworth not make all his guns of one piece? I will answer by again quoting his specification:—

The danger of a gun bursting from an over charge of gunpowder will be obviated, because the strain will be distributed throughout the length of the segments, and by forcing the hoops or belts to give way will cause the joints of the segments to open longitudinally, thus acting as safety valves, allowing the gases generated by the explosion to escape through the joints so opened. The piece may be spoiled by overstraining the parts, but its liability to burst will be prevented. In the case of heavy pieces of ordnance the facilities of transport are much increased, as by removing the hoops or belts the various parts may be disconnected and transported separately.

The escape of gas he obtained I have no doubt, and he may have been able to take his gun to pieces. I wish it, however, to be understood, that guns made on my plan do not possess these advantages. To enable the hoops to save the interior, they must grasp it far too tight ever to be removed, *and the gas I prefer to confine.* I need not take up any more of your time in proving that Mr. Whitworth contemplated neither the hooping of

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continuous tubes at all (as distinguished from tubes made of separate segments), nor putting on hoops with proper tension to prevent the escape of gas. As visitors go through the hall now, on leaving this theatre, I would ask them to look round. They will see several cannon, hundreds of years old, built of staves and hoops. I can assure Mr. Aston that I do not claim the invention of these. This would be an ill-chosen place to do so.

There are many inventors engaged in the same field of research we have discussed to-night, whom I have not named. This is not by any means because I undervalue their labours, but simply because I have not a sufficiently accurate knowledge of them, to lay it before this Institution.

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The Journal

OF THE

Royal United Service Institution.

VOL. IV. 1861. APPENDIX.

PROCEEDINGS OF THE THIRTIETH ANNIVERSARY MEETING.

THE THIRTIETH ANNIVERSARY MEETING of the Members was held in the Theatre of the INSTITUTION, on Saturday, March 2nd, 1861.

His Grace the DUKE OF SOMERSET, First Lord of the Admiralty, in the Chair.

I. The Proceedings of the last Anniversary Meeting were read.

II. The Proceedings of the Special General Meeting on the 3rd March were read.

III. The Annual Report of the COUNCIL was read as follows:—

1. In this, the Thirtieth Annual Report, and the first since the grant of a Royal Charter of Incorporation, the COUNCIL are able to congratulate the Members of the ROYAL UNITED SERVICE INSTITUTION upon the steady and decided progress which has been made during the past year. The COUNCIL have received letters from many of the Members, expressing approval of recent measures, and testifying to the increasing usefulness of the Institution.

2. While offering their thanks for the cordial co-operation afforded in answer to the appeal of last year's Report, the COUNCIL desire to draw attention to the fact, that military science is passing rapidly through new phases; this fact enhances the value of the Institution, and renders its effective support of higher importance to the United Services than at any former period.

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3. Some of the improvements referred to in last year's Report have been carried out. Considerable expense has thereby been entailed, but the increased support which has been received by the Institution has placed its finances in a condition equal to that of any previous year, and has improved its prospects, as will be seen by the following details.

Members.

4. The number of Members enrolled since the 1st of January, 1860, amounts to 300. The loss sustained by death is 98, by withdrawal 15; and the names of 13 have been removed from the list, in consequence of their subscriptions having remained unpaid for two years and upwards, notwithstanding repeated applications for them. The increase on the year is, therefore, 174, as compared with 98 in the previous year. A detailed statement of the changes among the Members, and a tabular analysis, showing the present state of the Institution compared with that of former years, appear on pages xv. and xvi.

Finance.

5. The usual General Abstract of Accounts for 1860, as audited on the 2nd of February, 1861, will be found on the opposite page.

Receipts.

6. The ordinary receipts have exceeded the amount estimated by £327. 812 Members have during the past year raised their Subscriptions from ten shillings to one pound and upwards; 124 Life Members have either paid an annual subscription of ten shillings or more, or have paid a further composition on their original life subscriptions. The donations have amounted to £14 2*s.*; the sale of the collection of Natural History produced £218 6*s.* 8*d.*; and a sum £876 14*s.*, being the legacies of Mrs. Watson and of Major-General Law, has been received.

Expenditure.

7. In consequence of the improvements made since last year's Report, and of the greater development of the Institution, the expenditure has exceeded the estimate, as follows: by sending the Journal direct to members through the post, in preference to the longer route through the Clothing Department, £48; in the purchase and binding of books, £14; for stamps, lithographing circulars to Volunteer Corps, and to Corresponding Members of Council, and for the alteration of dies, plates, &c., consequent upon the receipt of the Charter, £33; for printing the Annual Report, copies of the new Bye-laws and Charter, and papers relative to the change in the laws, laid before the Special General Meeting, a sum of £24.

The cost of the Journal exceeded the estimate by £89 in consequence of a large increase in the number of the Members, and a greater demand for it amongst the original Members. The cost of the Charter and the Corporation Seal was £221 0*s.* 6*d.* The latter sum, which may be considered as chargeable against capital, has been nearly covered by the receipt of £218 6*s.* 8*d.* from the sale of the Natural History Collection; a sum of £112 was expended for colouring and painting, rendered neces-

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GENERAL ABSTRACT OF THE ACCOUNTS OF THE ROYAL UNITED SERVICE INSTITUTION

FROM 1st JANUARY TO 31st DECEMBER, 1860.

EXPENDITURE.	Amount. £	s.	d.
Secretary's Salary	200	0	0
Clerk's do.	72	0	0
Servants' Wages	352	17	0
Do. Clothing	57	5	0
Fuel	54	6	6
Lighting	26	18	9
Postage	118	6	4
Fire Insurance	30	1	6
Library	114	5	3
Journals	589	10	10
Advertisements	32	5	9
Artificers, Carpenters, Ironmongers, Painters, Glazing, &c.	212	3	2
Stationery, Printing, Circulars, Tickets, &c.	123	1	11
Lectures	22	10	0
Assessed Taxes	86	17	7
Income Tax	2	5	0
Parish and Water Rates	105	9	2
Ground Rent	199	1	8
Domestic Sundries	17	7	10
Miscellaneous	58	6	11
Annuity to Malcolm	20	0	0
Stamps	7	5	6
Powers of Attorney	2	16	4
Reprints of early Journals	50	17	9
Annual Report	74	14	6
Re-arranging Charts, Maps, &c. in Topographical Room	10	12	6
Repairing and Painting outside of Building	52	10	0
Royal Charter	231	0	6
Total Expenditure	£2,923	17	3
Cash repaid to Agents	5	0	0
Balance of Petty Cash returned to Bankers	3	10	6
Invested in purchase of Consols	1153	5	9
Balance at Bankers on 31st December, 1860	177	19	10
Total	£4,263	13	4

RECEIPTS.	£	s.	d.	Amount. £	s.	d.
Balance at Bankers 31st December, 1859				46	1	1
Annual Subscriptions at 10s. for 1860	848	15	0			
Do. do. above	1,067	4	0			
Do. do. arrears	28	17	0			
Do. do. advance	16	10	0			
				1,961	6	0
Entrance Fees				298	0	0
Donations				14	2	0
Grant from Government				400	0	0
Life Subscriptions				397	10	0
Dividends				28	14	4
Sale of Natural History				218	6	8
Sale of Journals				19	2	6
Sale of Waste Paper				0	5	7
Legacy from Major-General W. H. Law, K.H. ret. full pay, 83rd Regt.				450	0	0
Do. from Mrs. Watson				426	14	8
Balance of Petty Cash returned to Bankers				3	10	6
Total				£4,263	13	4

London, 2nd February, 1861.

Examined and found correct, THO. SMITH. J. E. A. DOLBY. } Auditors.

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sary by the removal of the collection of natural history; the carriage of arms, accoutrements, &c., presented by foreign governments, entailed a further expense of £8 more than had been anticipated; an expense of £14 was incurred on improvements in lighting and warming the building during the lecture season; an addition of £50 per annum was made to the salary of the Secretary, an expense which was incurred by the COUNCIL after full consideration of the duties and responsibility now devolving on that officer. The total excess of expenditure over estimate is thus £613 0*s.* 6*d.*

8. The COUNCIL have continued to invest in Government Stock the Life Subscriptions received during the past year (of which £167 have been invested since 1st January), together with the sums received in composition of annual and increased life subscriptions, which, with the legacies of Mrs. Watson and Major-General Law, amount to £1,153 5*s.* 9*d.* The funded property of the Institution, therefore, now amounts to £2,360 5*s.* 8*d.* Three per Cent. Consols.

9. ESTIMATE OF PROBABLE RECEIPTS AND EXPENDITURE FOR 1861.

EXPENDITURE.	AMOUNT. £	s.	d.
Secretary's Salary	200	0	0
Clerk's Salary	72	0	0
Servants' Wages	356	0	0
Ditto Clothing	50	0	0
Fuel	55	0	0
Lighting	30	0	0
Postage	130	0	0
Insurance	29	5	0
Library	100	0	0
Journals	550	0	0
Advertisements	35	0	0
Artificers	60	0	0
Printing Circulars, Tickets, Stationery, &c.	100	0	0
Lectures	20	0	0
Assessed Taxes	88	0	0
Income Tax	2	10	0
Parish and Water Rates	105	0	0
Ground Rent	200	0	0
Domestic Sundries	20	0	0
Miscellaneous	50	0	0
Annuity to Malcolm	20	0	0
Reprint of early Journals	50	0	0
Printing Annual Report	50	0	0
Printing List of Members	50	0	0
Purchase of Models, and improvements in Museum	200	0	0
Ditto, and improvements in Naval Department	100	0	0
Purchases and improvements Topographical Department	50	0	0
Alteration in Lecture Theatre	40	0	0
Balance	84	15	0
Total	£2897	10	0

RECEIPTS.	AMOUNT. £	s.	d.
Annual Subscriptions:			
At 10*s.*	900	0	0
At £1 and upwards	1200	0	0
Entrance Fees	300	0	0
Dividends	66	0	0
Sale of Natural History	11	10	0
Sale of Journals	20	0	0
	£2497	10	0
Parliamentary Grant	400	0	0
	£2897	10	0
Total	£2897	10	0

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The Journal.

10. The arrangement by which Members, whilst serving abroad, can receive the Journal without paying the additional subscription of 10*s*. per annum, has given much satisfaction; in one regiment six officers, in another seven, in a third eight, and in a fourth twelve, have requested to be enrolled as Members of the Institution. The charge for its postage to Officers abroad amounts to a considerable sum, but this is more than compensated by the advantages afforded. This publication is now proving one of the great sources of the Institution's prosperity.

Topographical Department.

11. A complete Catalogue of the various maps, plans, drawings, &c., in this department is being made, and the Council trust to have them so arranged, as shortly to afford every facility for reference. The catalogue and arrangement of the charts have been completed. The charts published by the Admiralty, and the plans and maps by the Topographical Department of the War Office, have been regularly supplied; and the Institution is indebted to Lord Amherst for the present of a collection of maps and plans, chiefly manuscript, formed by his distinguished ancestor Field-Marshal Lord Amherst. The Council take this opportunity of expressing their sense of the great value of these donations to the Members.

Library.

12. Besides the books of reference purchased for the Library, the Council have received two additional volumes of a Naval and Military Journal from the Government of Denmark; one volume in addition to the Memoirs of the Topographical Depôt, St. Petersburg, from the Government of Russia; and from the Belgian Government two volumes of works on the survey of Belgium, with sundry other pamphlets.* A list of other works added to the Library during the past year will appear in the Appendix to Vol. IV. of the Journal.

Museum.

13. The Collection of Natural History, the sale of which was sanctioned at the Special General Meeting, has been disposed of for the sum of £229 16*s*. 8*d*. The rooms which it occupied have been re-coloured and painted, and are now set apart, one for Military Models, and the other for Foreign Accoutrements. The Museum has been enriched during the past year by liberal donations of arms, clothing, and accoutrements from the Governments of Denmark, France, Greece, Hanover, Holland, and Switzerland. Similar donations are expected from the United States of America, Bavaria, Russia, Saxony, Spain, and Sweden.

Lectures.

14. The Council take this opportunity of acknowledging their obligations to the officers and other gentlemen who delivered Lectures or read papers during the past season. They regret that they have been unable to obtain a lecture containing a complete *résumé* of the progress of naval and military science during the past year.

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* To the above should be added Nos. 21, 22, and 23, of the Topographical and Military Map of the Netherlands, presented by the Netherlands Government.—Ed.

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Honorary Members.

15. The Council have much gratification in announcing that Lady Franklin has become an Honorary Member.

Corresponding Members of Council.

16. The Council being of opinion that it is desirable to have in each regiment and depôt of the Army, and on each Naval station, some officer who would more particularly forward the interests of the Institution, have revived the office of Corresponding Member of Council, and to their appeal seventy-eight have already responded. The warm thanks of the Institution are due to these gentlemen for the great assistance which they have afforded.

Vice-Patrons.

17. The Council regret to record the death of the Duke of Norfolk, who took a great interest in the Institution; also that of the Duke of Richmond and of Field-Marshal the Earl of Strafford. The latter two noblemen participated in the great events of one of the brightest periods in our military history; at the close of the battle of Waterloo, the Earl of Strafford commanded the first division of the army.

18. General Lord Clyde, for many years a Member, has accepted the office of Vice-Patron of the Institution.

Vice-President.

19. By the death of Captain Ford, the Institution has lost not only one of its oldest, but one who, as long as health permitted, was among its most active Members.

Bequest.

20. The death of Major-General Law has deprived the Institution of a most zealous friend. The Institution is indebted to him for the munificent bequest of £500. The Major-General served for some time in the Peninsular War.

Volunteer Corps.

21. The Council recommended an alteration in the laws, with a view to the admission of the officers of this patriotic body on the same footing as those of the regular services. Sanction was given at the special general meeting, on the 3rd March, 1860, and they are now eligible.

Trafalgar Model.

22. The artist has been unable to complete this model by the time anticipated, but considerable progress has been made, as may be perceived on visiting the Naval Model room.

In Conclusion.—Their anticipations having been hitherto fully realised, the Council look with confidence to the future. With a view to further progress, the assistance of every Member of the Institution is earnestly desired, and the Council suggest that most effective aid may be afforded by officers serving abroad transmitting papers for evening readings, and for subsequent notice or insertion in the Journal.

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IV. Colonel JOHN CLARKE KENNEDY, C.B.—

MY LORD DUKE, and GENTLEMEN.—In submitting to you the Resolution with which I have had the honour of being entrusted, namely, "That the Report now read be adopted and printed for circulation among the Members," I will not detain you with many remarks; still there are several points which I think ought to be brought distinctly to the notice of the Members now present. Last year, when we met in this room, we were full of anticipation of the increasing advantages and prosperity of the Institution. This year, I think we may congratulate ourselves that the events of the last twelve months have fully borne out the anticipations which we then formed. The liberality of many of the Members of the Institution, to the number of upwards of 800, in increasing their subscriptions from 10*s.* to £1 and upwards, should not be passed over without remark. The extension of the circulation of our Journal is, perhaps, after all, the most important event of the past year. The instruction which we who reside in the neighbourhood receive in this room, is now carried from one end of the world to the other, by the Journal being distributed amongst our brother officers of both services who are serving abroad. The great advantages which naval and military science will derive from this distribution of our Proceedings, needs very little remark from me; it is self-evident. The very fact of the Journal being distributed throughout our colonies will in time, I hope, bear fruits, by the officers, who must have much spare time abroad, devoting that spare time to sending us the results of their observations and their experience. I therefore think, and I am sure the Meeting will agree with me, that the money that we have expended upon it, though large the sum may appear, has been well and satisfactorily laid out. With regard to the Library and Museum, any of us who are in the habit of spending a few hours here occasionally, will also bear testimony to the great improvements which have taken place during the past year. Any one who visits the Equipment Room, who visits the Library, who wishes to inspect a plan, can at once through, I must say, the ever ready courtesy of our Secretary and the Officers of the Institution, find any book or any plan he wants without the slightest difficulty. This is no slight advantage to a body of officers who can only, in their own houses, have but a limited library. As to the Lectures, I believe I shall be borne out in stating, that during the past year they have been even more interesting than in former years. It would be invidious indeed, on my part, to name specially any gentlemen who have favoured us with the result of their labours; but, in stating that I think the Meeting should give these gentlemen their thanks, I am sure I am only expressing the opinions of you all. There is one point upon which I am afraid we have been, perhaps, a little disappointed. Last year we were in hopes that those gentlemen who have voluntarily joined us in the service of their Queen and country, would also have joined us in supporting this Institution. Some, certainly, have done so; and I only hope that, when they have got through a little more of their drill, they will come and join us, with a view of extending, what I may almost call, their professional knowledge. Most of us are connected with friends in the Volunteers, and, I think, each of us ought to exert himself to induce as many officers of the Volunteer force as possible, to become Members of this Institution. I will not detain you any longer, but will move, "That the Report now read be adopted and printed for circulation among the Members."

Rear-Admiral AUSTIN, C.B. seconded the Resolution.

Lieutenant GARDINER, R.N.—

I beg leave to call your Grace's attention to the fact, that last year this Institution was incorporated, and up to the present moment, I have heard, the bye-laws have not had the seal of the Corporation affixed to them; and until that seal is affixed at a General Meeting, they are void, Therefore this Meeting is summoned by a Council that has not been duly elected. It is utterly impossible to get rid of that fact, because these bye-laws, to be binding upon the Institution, should have the common seal affixed to them. I think your Grace will bear me out, that I am not incorrect in the statement I now make. I would suggest, with all sincerity, not wishing to create difficulties, that we should refer these bye-laws to a Committee, who should draw them up and have them properly framed, and then submit them to a General Meeting, to have the common seal affixed. Then you will be in a position to carry them out; but until that is done, they are of no more value than the paper they are written on.

Lieutenant Gardiner then quoted an authority on the subject, and sub-

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mitted that the Bye-Laws, as they at present stood, were not in conformity with the laws of the land.

Captain E. G. FISHBOURNE, R.N. C.B. Chairman of the COUNCIL—

Perhaps the hon. gentleman will make a substantive proposition on the subject. He made a proposition last year, but there was nobody to second it.

Lieutenant GARDINER—

I will move then, "That a Committee of not less than five Members be appointed to draw up the heads for the proposed bye-laws; and that the same be submitted to counsel, to see that they are in conformity with the Charter."

Captain FISHBOURNE—

It does not appear from the Charter, that it is necessary to attach the seal to the bye-laws. Certainly, the wording of the Charter does not imply it, whatever may be the usage. It strikes me that our legal adviser would have advised us, if it had been necessary to proceed as Lieut. Gardiner proposes. It says, "That the said General Meeting shall from time to time make and establish such bye-laws, and vary, and alter, and revoke the same, as they shall deem to be useful and necessary for the election of President, Vice-Presidents, and Council, and for the regulation of the said body politic and corporate, for the admission and expulsion of Members, and of honorary and foreign Members; so that such bye-laws be not repugnant to these presents, or to the laws and statutes of this our realm; and shall and may also enter into any resolution, and make any regulation, respecting the affairs of the said body politic and corporate, that may be necessary and proper, and shall not be repugnant to these presents or to the said laws and statutes." It is to be presumed, and we know it to be a fact, that the Charter is granted by the legal advisers of the Crown. They would not grant it, if it contained any provision that is contrary to the laws of the land. We are not in the least responsible for the Charter. The fact that it is granted by the legal advisers of the Crown, is a substantial proof to us that it does not contain anything contrary to the laws of the land.

The DUKE of SOMERSET—

Does any one second this amendment?

Vice-Admiral J. N. TAYLER, C.B.—

I do not rise to second the amendment; but I think if one of the COUNCIL, who is well acquainted with everything that is going on, would second it, it might prevent disputes arising, and you would be carrying out the Charter in a regular form, and avoiding the rocks and shoals that we may be likely to split upon.

Lieutenant-General FOX—

I do not see why the COUNCIL should be called upon to second that in which they do not agree.

Vice-Admiral TAYLER—

If they do not agree in it, of course the responsibility falls upon them.

Colonel the Hon. JAMES LINDSAY, M.P. Vice-Chairman of the COUNCIL—

There is this to be said: if the COUNCIL were in error, twelve months have elapsed since the last Meeting, and it has been perfectly competent for Lieut. Gardiner, in a friendly manner, to go to the Secretary or to our Lawyer—and he was invited to do so—to state what his views were. We are only anxious to pass such laws as would be not only binding upon this Institution, but agreeable to all the Members. He might have come down here in a friendly way at any period within the last twelve months, or

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he might at the same time have expressed his opinions, according to the laws, fourteen days ago, by putting up a notice in the Library and Reading Room, to say that he was going to bring such a question forward. That opportunity was not taken by Lieut. Gardiner. I apprehend that the question now before the Meeting is, whether the Report shall be printed and circulated; and if Lieut. Gardiner thinks the bye-laws should be referred to a Committee, he has power by the law to get a certain specified number of signatures for the purpose of calling a Special Meeting and taking that subject into consideration.

Lieutenant GARDINER—

I perfectly ignore the bye-laws as being illegal, not having the common seal o. the Corporation affixed thereto. (Cries of "Spoke! spoke!")

General Sir CHARLES PASLEY, K.C.B. R.E.—

May I be allowed to say a word? This gentleman, in the authority he quoted, speaks of the COUNCIL as an invisible body. I see the Members here before me: then, how can they be invisible? And as to seals, I have been reading lately the "Lives of the Lord Chancellors," and of the Lords Chief Justices, and I find that in early times the nobility and the gentry who had to make the laws could not write, therefore they had great seals. But what use the seal is in the present day I cannot tell. I think the gentleman's objections are perfectly futile, and not to be maintained; and therefore I put a complete negative upon them, as far as my opinion goes.

Lieutenant GARDINER—

Before your Grace puts the resolution, there are some items in the account that I object to. There are annuities here which are not allowable. There is an annuity here of £20, which I think is not allowable; and in going through the accounts, I find a sum appropriated to the printing of the Journal. I am one of the original Subscribers, and we were told that the Journal was not to throw any expense upon the Members, other than those who chose to subscribe to it. Now, I find there is a sum of £175 taken from the General Fund of the Institution to publish the Journal. And there is more than that; I find the whole of the Life Subscriptions and the two Bequests which have been given have not been wholly invested: the sums received for Life Subscriptions and Legacies amount to £1,274; the invested money amounts to £1,153, leaving a balance of £121 unaccounted for. The balance stated by the account is £177 19*s*. 10*d*.; I make a balance of only £57 0*s*. 11*d*. I think these points require some explanation.

Colonel LINDSAY—

The amount of the Legacies, though they appear to be £500 a-piece, we do not get, because there is the succession duty and income-tax to be paid.

Lieutenant GARDINER—

I have only taken the two Legacies at £876.

Colonel LINDSAY—

All I can tell the hon. gentleman is, that we have invested every item of Life Subscriptions that we have received, and also the Legacies. The amount of Life Subscriptions is not caused by new Life Subscribers altogether, but by a great many additions to the original Life Subscriptions; the increased Life Subscriptions being £3 added to the original £6, that £3 being the composition for those who wish to have the Journal. With regard to the Journal, the amount expended last year upon it was £589; we have 1,155 Members who have increased their subscriptions to £1 and upwards; we have 182 Life Members who have given the increased composition in order to receive the Journal; we have 49 Life Members, who, instead of giving an increased composition, pay an extra annual sum of 10*s*. Taking the half of 1,155, and

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the half of 49 Members who pay the increased subscription, that brings it up to £602 a year towards the Journal; and the increased Life Subscriptions from the above 182 Members, amounting to £546, divided over a period of 12 years, will leave £45 to be added to the £602 towards the Journal, making a grand total of £647, whilst the gross expense of its publication last year was £589, so that we have actually received more than it costs in publication. Besides that, the Government gives us a sum of money every year for the purpose of increasing the scientific character of this Institution. I apprehend that, with the Lectures given in this Theatre, the publication of the Journal, and its circulation to all parts of the world, in propagating science by means of the Lectures here, conveying it to our officers abroad, and letting them know what we are doing at home, we are carrying out the intention of the Government; and a portion of the sum of money which we receive from them properly goes to the account of the Journal; consequently, so far from the original Members paying for its publication, the Journal is actually self-supporting.

The Resolution was then put to the Meeting, and carried.

V. The names of eight Members retiring from the COUNCIL by rotation were read:—

Captain RYDER, R.N.	Captain PACKE.
Major COOKE, R.E.	Captain FISHBOURNE, R.N. C.B.
Lieut.-Colonel STUART, M.P.	Captain JEFFERSON.
Captain COLLINSON, R.N. C.B.	Captain Sir SIBBALD SCOTT, Bart.

VI. Colonel HART—

I beg leave to propose:
"That the thanks of this Meeting be given to the Members of the COUNCIL who retire by rotation, and that the following Members be elected to fill the vacancies":—

Captain COLLINSON, R.N., C.B.	For Re-election.	Captain BARNETT, R.N.
Captain FISHBOURNE, R.N., C.B.		Lieut.-Colonel FLETCHER, Sco. Fus. Gds.
Captain JEFFERSON, late Ceylon Rifles.		Colonel ADAIR, Suffolk Mil. Art.
Captain HOUSTON, R.N.		Captain HALSTED, R.N.

B. OLIVEIRA, Esq.—

I have the honour to second that resolution, and in doing so, I may take the liberty of observing, that when travelling in the Mediterranean I have had occasion to remark that the publications of the Institution are of great utility. I have frequently seen them at the different messes at Malta and Gibraltar with great satisfaction, and I think I may venture to say that the circulation of the Journal has induced a great number of officers to join the Institution.

The Resolution was put from the Chair and carried unanimously.

VII. Lieutenant-Colonel MAN—

My Lord Duke, I have the pleasure of proposing,
"That the thanks of this Meeting be given to the Auditors for their valuable services, and that the following gentlemen be elected for the ensuing year:—

HENRY ELLIOT, Esq.	Captain J. E. A. DOLBY.
THOMAS SMITH, Esq.	M. F. DOWNES, Esq."

Major PORTER, R.E.—

Having been requested to second this resolution, I intended to have done so without troubling the Meeting with any observations; but after the discussion which has just taken place, perhaps it will be right for me to state, that I have been appointed the Official Member of the COUNCIL by the Secretary-at-War to report upon the Institution, in order that his Lordship may be guided as regards the future grants to be

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given to it. I have every reason to hope, that my report on the next occasion will be satisfactory, and I think it will be well for me to state, that I shall dwell with considerable satisfaction upon the Journal, as being one of the most valuable instruments which the Institution possesses, for circulating a knowledge of naval and military science amongst those of our Members who are obliged by professional duties to be absent, not only from London, but from the country.

The Resolution was put from the Chair and carried unanimously.

VIII. Colonel LINDSAY—

I have to move an Amendment in the Laws, notice of which has been duly posted in the Reading Room. Section V. paragraph 3, runs thus:—

"The funds of the Institution, and all Life Subscriptions and Legacies shall be invested in eligible securities in the names of Trustees, selected by the COUNCIL, with the approbation and concurrence of a General Meeting."

That is the law as it at present stands. After the Charter had been granted, it was ascertained that was it not necessary to have Trustees, and that it would cause considerable inconvenience: it was found that other bodies who had received a Charter of Incorporation had their funds invested in the general body of the members, through the agency of the charter and its seal; consequently, trustees are an inconvenience, for the moment a Trustee dies you have to find another to supply his place. There is considerable expense attending that transaction. Therefore we propose, in lieu of the section, as it stands, to substitute the following:—

"That the funds of the Institution, and all Life Subscriptions and Legacies, shall be invested in the name of the Corporation in eligible securities, to be selected by the COUNCIL."

I have also another Amendment to propose in Section VIII. which runs thus:—

"Should it be proposed to make or repeal a bye-law," &c.

I propose to insert the word "amend," so that it will read:—

"Should it be proposed to make, *amend*, or repeal a bye-law," &c.

W. S. LACON, Esq.—

I beg to second that motion.

Major-General BOILEAU—

I would wish to make an observation with reference to the second of these propositions, not with any intention of objecting to it, but to suggest a word which, I think, would be more appropriate to the object which Colonel Lindsay has in view. I would suggest that the word "alter" would be a better word than "amend," because "amend" has a specific meaning—to "improve." The object is to alter, I have no doubt; but, with regard to an improvement, that may lead to discussion. Having had a great deal to do with committees in my time, I think the term usually used is "alter," and not "amend." If not objectionable, I think that would be the better word.

Colonel LINDSAY—

I have no objection to take the word "alter," so that it will read, "make, alter, or repeal any bye-law."

The Resolution was put from the Chair and carried unanimously.

IX. Colonel P. J. YORKE, F.R.S. Vice-President—

The resolution which I hold in my hand is to this effect: "That, in accordance with a notice suspended for fourteen days in the Reading Room, this Meeting do authorise the COUNCIL to dispose of such Chinese and Indian curiosities, together with Roman and other antiquities as are not of naval or military interest." This resolution becomes necessary, in order to carry out the views already adopted by the General Meeting last year, and in accordance with some change lately made in the design of this Institution. At the commencement of this Institution, the Members who took a leading part in found-

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ing it did not limit it to the objects that we now find it necessary to do. In the early days of the Institution, it was attempted to make collections here of all kinds. We had collections of natural history, of antiquities, and of various other objects; but in progress of time that was found to be impossible, because no place would hold all the objects that came in; and from the number of other Museums and public Institutions in the metropolis, it was thought it would be much more advantageous to give the Institution a more specific character, and to limit it entirely, or nearly so, to objects that had some naval or military interest. It is in accordance with that view that I now submit this resolution to the Meeting. The purpose of it, is to give the COUNCIL an opportunity to dispose of such of these curiosities as are not of professional interest. The COUNCIL do not propose to do this in a hurried manner; they propose to consult, as far as possible, the wishes of the donors. Some of the objects are of considerable value and interest; and the intention is, that they may be disposed of in the way that may be most agreeable to the donors.

Lieutenant-Colonel LE COUTEUR, Coldstream Guards—

I beg to second this motion.

Lieutenant-General FOX—

Having been absent, in consequence of illness, I am not aware whether this point has been discussed in the COUNCIL; but I should like to know whether the objects named in this Resolution include the ancient Greek and Roman coins, which I should be very sorry to see sold. It is a great object for numismatic science, that officers should collect coins when they are abroad, and give them to the Museum; and, as they occupy very little space, I do not think they should be disposed of.

Colonel YORKE—

It is not intended to dispose of them.

Colonel LINDSAY—

The coins are in the Library.

Sir CHARLES PASLEY—

By permission of the President, it strikes me that the donors of any curiosities should always be consulted as to the disposal of them. Thinking it would be for the benefit of science, I gave a number of philosophical instruments, a copy of the Transactions of the Royal Society, and the East India Registers, to the Scientific Institution formed at Chatham. Well, they sold them. I would willingly have paid the whole value of the things, to have had them again. I was deprived of that opportunity, and I feel it would be rather a hardship if the donors to this Institution were to be treated in the same way.

Rear-Admiral Sir G. LAMBERT, K.C.B.—

I beg to state, that, having been a donor to this Institution, as regards a great many cases of natural history—birds, and things of that sort—I did have that compliment paid to me when they were disposed of, and I feel quite sure that nothing will be disposed of without taking into consideration the wishes of the donors.

The Resolution was then put from the Chair and carried unanimously.

The CHAIRMAN announced that the business of the Meeting was concluded.

(Signed) SOMERSET,
Chairman.
B. BURGESS, Captain,
Secretary.

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Captain FISHBOURNE—

I have the pleasure of moving that General Fox do take the Chair.

Lieutenant-General Fox accordingly took the Chair.

Colonel A. SHAFTO ADAIR—

In rising to propose the Resolution with which I have been entrusted, I am sure I may infer that it will meet with the cordial support and sympathy of all officers here present. It is a great satisfaction to us to find, that the efforts made by the officers of the United Services to promote the scientific knowledge and development of all that concerns the efficiency of both, is recognised by those who are not immediately connected with us. It is still a greater satisfaction to find that those who are placed by the Constitution of our country at the civil head of these two great Services, honour us with their presence on these occasions. Therefore it is, and I am sure I shall have been anticipated in the Resolution, that I propose the thanks of this Meeting to the First Lord of the Admiralty, who has honoured us by presiding on this occasion. I think it is of especial advantage at this moment, when in the great department of the public service over which he presides, as well as in that of the sister Service, experiments are being made, which will lead, I trust, to but one conclusion—the preservation unabated, of the supremacy of Her Majesty's forces by land and sea as it has been hitherto. Perhaps I may be permitted at this moment to refer to that special department over which the noble Duke presides It has set an example of exceeding value, in not limiting the experiments which are designed to improve the fitting, the form, the speed, the capacity, and armaments of our vessels, to the royal dockyards alone, but in drawing information from any quarter from which it may be obtained. Therefore, feeling it perfectly unnecessary to dilate on the merits of that department, which are recognised by all, I will conclude by moving, "That the thanks of this Meeting be given to His Grace the Duke of Somerset, for his kindness in presiding in the Chair on this occasion."

Sir GEORGE LAMBERT—

I have great pleasure in seconding the Resolution. I am quite convinced that nothing can be more serviceable to this Institution than to be supported by the heads of departments. They give a tone to the Meetings by their presence, and enable us to look forward to the carrying out of the advantages to be derived from the information that is constantly being laid before the public by this Institution. I trust on future occasions we shall find the same good feeling existing which has been shown to-day, and that no impediments will be thrown in the way of promoting the objects of the Institution.

The CHAIRMAN—

I feel greatly honoured in being called upon to take the Chair in order to give the unanimous thanks of this Meeting to my old friend the Duke of Somerset, who fills office, I believe, with the most perfect satisfaction to the Service over which he presides, and who has given up time which is so valuable elsewhere, that he may come down here and assist us in the objects of our Institution.

The Resolution was put to the Meeting and carried with acclamation.

The Duke of SOMERSET—

GENERAL FOX and GENTLEMEN,—I have come here to-day because I take great interest in this Institution, and because I believe the public interest in it will spread more and more as time advances. Every day we observe the progress that science is making, and the practical application of science to both naval and military purposes; and, as this goes on, the value of this Institution must be more generally known. In the first place, I may congratulate you upon the financial statement we have heard to-day. It shows that you are in a sound financial condition, and I only hope that other financial state-

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ments made elsewhere will be equally satisfactory. With regard to the Museum, I think you have done wisely in limiting it to the special purposes for which it ought to be maintained. I have had great experience in museums, from the British Museum downwards. The great danger and difficulty in all museums is the tendency to bring in and accumulate things that are not really wanted. When gifts are offered, the difficulty is to exclude them. First, one thing is given, in some way connected with the objects of the collection, though not strictly so, and then another, until at last the whole museum becomes a confused heap; you cannot conveniently find what you may be looking for, and there is no room left for what is really desirable. I was connected with the Museum of Practical Geology in Jermyn-street when it was first started, and the arrangement we made with Sir Henry de la Beche was, that it should be strictly confined to the one object for which it was established, but we had the greatest difficulty in carrying the rule out. The resolution you have passed to-day upon the subject of your Museum appears to me a wise one. With regard to lectures, I observe the COUNCIL express their regret that they have been unable to obtain a lecture containing a complete *résumé* of the progress of military and naval science during the past year. I am not surprised at that, when I look at the progress naval and military science has made during the year. I am not surprised that no one will take upon himself to lay it all down exactly in a lecture here. It will be a very difficult task to undertake, at least unless a person had more presumption than I should think any Member of this Institution has. At the same time, I may say it is of the greatest value to have an Institution of this kind, where lectures on naval and military science are given, because a great deal of information might otherwise be lost. I know, in regard to the Navy, a great many things are discovered, and are put aside for the want of a proper place to preserve them. Many years afterwards, what are thought to be discoveries are made, and we often find, if we had looked back and consulted our papers, that the discoveries had been made a long time ago. That is continually occurring, and it shows of what great advantage an institution of this kind may be, in recording information of this character and communicating it throughout the Services. It may save other people a great deal of time, for, if they are pursuing any particular study, they know where to go and how to look for it. As regards the particular pursuits to which we are directing the minds of both Services, so many questions present themselves, that they can only just be touched upon. For instance, there is the whole question of gunnery, cannon, and projectiles. During the past year experiments have been tried. Every day new information comes. It was but two days ago I received an interesting report from Prussia upon the subject of their trials. We have such a variety of information upon this subject, that it is most desirable these trials should be carefully watched and followed out. If any one has energy enough to extend his inquiries still further, there is the whole question of the defence of the country, upon which there still exists a great variety of opinion. If I look back to the opinions prevailing eighteen months ago, I find that those opinions are already very much modified. Then, again, we come to the great question of iron or wooden ships. What strikes me with regard to this question—indeed, with regard to many other scientific questions—is, that they should be taken up in a philosophical spirit, instead of being taken up, as they too often are, in a very bitter sectarian spirit. They are treated as if it was a question of theology. You have the advocates of wood on the one side, and the advocates of iron on the other, calling each other names, as if scepticism was a crime and doubt a deadly sin. Now, I think the fair way, as they are philosophical questions, is to deal with them in a philosophical spirit. Let us ascertain what is best to be done in these questions. They are not easy of solution. It is only by treating them as a matter of faith that you make them easy. If you adopt as a matter of faith that So-and-So is quite right, and that whoever says to the contrary has a bad motive and is a dishonest fellow, why, you may settle the question easily in your own mind, but you do not settle it to the interest of the country. What we have to do is to look at these questions calmly in all their bearings; and I am sure if that were done we should then arrive at a satisfactory result. With respect to this very question of iron, for instance, lately the Government appointed a commission to examine the question of the quality of iron; because, when we came to test these experiments on iron, the first thing I asked was, "What do you call iron?" "Well," was the reply, "everybody knows what iron is." But when I sent for a person who does know something about it, Dr. Percy, of the Museum of Practical Geology, he informed me of the very great difficulties there were in the question, and he said we should

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find there were many sorts of iron, possessing different degrees of resistance, and that the question required to be looked into. I remember, when I was in the office of Commissioner of Works, we were putting up the bronzes on the Nelson monument in Trafalgar Square. When I went into the office I was told they were going to order another of these bronzes. I asked if they had entered into the contract, and I was told the late Government had made the contract. I asked if they knew it was really bronze; I said, "Supposing the proper mixture is not made—suppose a bad metal is put in, have we any legal remedy?" "No," they said, "the contract is worded in such a manner, that, if you do not get good metal put into the mould, you must have what they choose to give you: you are at the mercy of the trade." That arose from the want of a little practical knowledge of the subject. Now, I conceive an Institution like this will be of great use in directing attention to matters of that kind which more particularly affect the naval and military professions. I have come here with an earnest desire to see this Institution advance, and to urge upon you, whenever experiments are going on, to procure records of them, and to ascertain that they have been fully and fairly tried. I am sure you will take in good spirit the suggestion I have thrown out, and I beg to thank you very sincerely for the honour you have done me.

Statement of Changes among the Members since 1st January, 1860:—

	Life.		Annual.		Total.
Number of Members on 1st January, 1860 .	831	+	2513	=	3344
Do. who have joined during 1860 .	23		277		300
	854		2790		3644
Changed from Annual to Life . . .	+ 7		— 7		
	861		2783		3644
	Life.	Annual.			
Deduct—Deaths during 1860 . .	28	70			
Withdrawals . . .		15			
Struck off . . .		13			
	28		98		126
Number of Members on 1st January, 1861.. Total	833		2685		3518

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TABULAR ANALYSIS OF THE STATE OF THE INSTITUTION,
To the 31st of December, 1860.

Year. 1st Jan. to 31st Dec.	Annual Subs. received.	Entrance Fees.	Income (from all sources).*	Life Subs. received.	Amount of Stock.	Invested in the purchase of Books, &c.	No. of Vols. in Library.	No. of Members on the 31st Dec.	Number of Visitors.
	£	£	£	£	£	£			
1831	654	..	654	1,194	..	..	..	1,437	..
1832	1,146	..	1,146	973	..	..	..	2,699	..
1833	1,405	..	1,450	692	..	..	..	3,341	..
1834	1,500	..	1,549	583	1,100	..	..	3,748	13,376
1835	1,480	..	1,574	366	2,430	40	..	4,155	8,537
1836	1,570	..	1,682	330	3,747	45	..	4,069	8,521
1837	1,549	..	1,747	222	4,747	180	..	4,164	10,907
1838	1,462	..	1,634	230	5,500	246	..	4,175	15,788
1839	1,399	..	1,565	168	5,500	292	..	4,186	16,248
1840	1,363	..	1,525	198	5,500	446	5,500	4,257	17,120
1841	1,450	..	1,643	186	6,000	243	5,850	4,243	19,421
1842	1,373	..	1,565	144	6,400	373	6,450	4,127	21,552
1843	1,299	..	1,494	140	6,700	237	7,000	4,078	27,056
1844	1,274	..	1,408	112	3,000	298	7,850	3,968	22,767
1845	1,313	..	1,466	228	1,500	127	8,100	3,988	21,627
1846	1,298	..	1,456	138	1,500	74	8,410	4,031	32,885
1847	1,314	74	1,502	132	1,700	37	..	4,017	38,699
1848	1,175	57	1,375	48	1,700	85	9,641	3,947	37,140
1849	1,176	72	1,375	84	1,150	58	..	3,970	33,333
1850	1,141	106	1,294	198	600	36	..	3,998	33,773
1851	1,136	131	1,292	66	666	34	10,150	3,188	52,173
1852	1,134	133	1,281	114	200	43	10,300	3,078	20,609
1853	1,243	319	1,684	264	528	41	10,420	3,251	25,952
1854	1,200	138	1,368	126	612	95	10,587	3,171	22,661
1855	1,159	107	1,289	120	653	55	10,780	3,131	14,778
1856	1,216	197	1,519	156	761	47	10,832	3,204	16,184
1857	1,258	176	1,937	78	1,038	40	10,960	3,168	12,755
1858	1,318	221	2,102	105	438	31	11,062	3,246	25,747
1859	1,526	195	2,277	512	946	70	11,320	3,344	28,739
1860	1,961	298	3,577	397	2,178	114	11,517	3,518	28,011

* Including Annual Subscriptions, Entrance Fees, Donations, Legacies, and Interest on Funded Property; and also the grant from Government, commencing in 1857.

LIST OF DONATIONS

From 1st January to 31st December, 1860.

	£	s.	d.
Carter, W. G., F.S.A., *Esq.* Solicitor Sco. Fus. Gds.	1	1	0
Cautley, *Sir* Proby T. Col. ret. Bengal Army	2	0	0
Vyvyan, R. H. S. Lieut. Duke of Cornwall's Rang.	1	1	0
Carried forward	£4	2	0

	£	s.	d.
Brought forward	4	2	0
West, *Sir* John, G.C.B. Admiral of the Fleet	5	0	0
Pollard, J. P. *Esq.* late Audit Office	3	0	0
Mundy, G. V. Col. 19th Regt.	2	0	0
Total . .	£14	2	0

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LIST OF NEW MEMBERS

WHO JOINED THE INSTITUTION SINCE THE LAST EVENING MEETING IN 1860 (JUNE 4TH).

LIFE MEMBERS.

Arrow, W. G., Major H.M. 28th Bombay N.I.
Brown, Jno., late Mid. H.E.I.C.S8.
Blundell, H. B. H., Lieut. Rifle Brigade.
Charlewood, E. P., Capt. R.N.
Collings, J. E., Lieut.-Col. 33rd Regt.
Chichester, Hon. G. C., Lt.-Col. 77th Regt.
Dyer, S. H., Capt. 8th King's.
Hincks, A. S., Ens. 3rd W.I. Regt.
Halsey, H. W. R. W., Deputy-Lieut. Sussex
Hope, W., *CB.*, Lt.-Col. 71st Highlndrs.
Herbert, Hon. A. W. E. M., Lieut. 7th Hussars.
Jones, H. M., Major 73rd Regt.
Lennox, W. O., Lt.-Col. R.E.
Paynter, J. A., Capt. R.N.
Stanley, *the Right Hon. Lord, M.P., P.C.*
Taylor, W., Capt. Mid. Rifle Vol.

ANNUAL SUBSCRIBERS.

Adair, H. A., Lieut. 52nd Regt.
Alston, W. E. *M.D.*, Staff Assist. Surg.
Anstruther, P. R., Lieut. 94th Regt.
Ashford, H. W., Ens. 100th Regt.
Aufrere, G., Capt. late 20th Lt. Dgs.
Aylmer, J. E. F., Lieut. 8th King's.
Aytoun, J. Capt. 7th Hussars.
Baker, Valentine, Lt.-Col. 10th Hussars.
Baldwin, F. C., Ens. Ceylon Rifles.
Banks, C., late Sec. to Kilmainham Hosp.
Bayly, C. J., Governor of the Bahamas
Beere, D., Capt. 8th King's.
Bellamy, P. L., Capt. 55th Regt.
Bellers, R. B., Capt. late 50th Regt.
Bertram, C. P., Bt.-Major 41st Regt.
Blair, J. B., Ens. 6th Regt.
Blane, C. G., Capt. 23rd R. W. Fus.
Blinkhorn, W., Capt. 7th Drag. Gds.
Boom, A. S., Ens. late Roy. Elthorne Mil.
Boyce, A. W., Capt. 34th Regt.
Brabant, E. Y., Ens. Cape Mounted Rifles.
Breen, H. H., Adm. to Gov. of St. Lucia.
Brereton, W., *CB.*, Maj.-Gen. R.A.
Brown, C. B., Lieut. 8th King's.
Buchanan, J. R. G., Ens. 26th Regt.
Budd, R., Lt.-Col. 14th Regt.
Burn, R. D., *M.D.*, Assist. Surg. R.A.
Burton, H. A., Lieut. 14th Regt.
Butler, W. G., Ens. 94th Regt.
Carroll, W. J., Lieut. R.E.
Cleeve, S. A., Capt. 51st Regt.
Cobbe, C., Capt. 13th Lt. Infantry.
Colls, R. S., Major 32nd Regt.
Colthurst, D. L., Major 17th Regt.
Cookesley, A. F., Dy. Com. Gen.
Costin, C., Lieut. and Adjt. 14th Regt.
Cowburn, T. B., Lieut. 52nd Lt. Infantry
Dawes, E. A., Capt. and Adjt. Aberdeen Highlanders.
Decie, R., Lieut. R.E.
De Thoren, O. W., Ens. 45th Regt.
Dewar, A., Capt. late 87th Roy. I. Fusiliers
De Winton, F. W., Capt. R.A.
D'Eye, W. R., Capt. 91st Regt.
Docker, E. S., Staff Surgeon.
Dunlevie, W. T. H., Lieut. 12th Regt.
East, C. J., Lieut. 82nd Regt.
Elliot, A. C., Capt. 94th Regt.
Elliot, F. H., Lieut. 94th Regt.
Ellis, C. H. F., Lieut. R.A.
Eustace, T. F., Lieut. 49th Regt.
Fair, A., Paymaster 17th Depot Batt.
Filgate, T. P. M., Lieut. 18th Hussars.
Fitzgerald, F. A., Capt. 12th Regt.
Fitzgerald, R. P., Lieut. R.N.
Frampton, W.J., Lieut. 7th Roy. Fusiliers.
Gage, *Viscount*, Major late Sussex Mil.
Gale, H. R. H., Capt. Mil. Train.
Gammell, J. H. H., Capt. 9th Regt.
Gardiner, R., Col. I. F. Officer, Cork.
Gardiner, T., Lieut. 98th Regt.
Gibbons, T., Surgeon 95th Regt.
Glover, F. G. E., Lieut. 43rd Lt. Infantry
Godbold, A. B., Lieut. 1st R. Surrey Mil.
Goepel, P. D., Lieut. Hon. A. Compy.
Grahame, Geo. Quar.-Master 21st Royal N. B. Fus.
Grant, G. F., Lieut. 62nd Regt.
Granville, B., Major 23rd R. W. Fusiliers.
Grogan, C. E., Capt. 14th Regt.
Gubbings, T., Lt.-Col. 2nd W. I. Regt.
Gubbins, J., Major 23rd R. W. Fus.
Haig, J. F., Lieut. 90th Lt. Infantry
Hamilton, L. H., Major 87th R. I. Fus.

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Harnett, E., Capt. 11th Hussars.
Harrison, W. A., As. Sur. Hants Mil. Art.
Harvey, C. L., Lieut. 91st Regt.
Henslowe, S. V. F., Capt. 73rd Regt.
Holt, A., Capt. 21st R. N. B. Fus.
Holt, J., Capt. H.M. 20th Bombay N. I.
Hooke, H. H., Ens. 45th Regt.
Hosier, H. M., Lieut. R.A.
Hutchinson, H. M. L., Ens. 14th Regt.
Ingles, *Sir* Jno., Major-Gen., K.C.B.
Isacke, R. J., Lieut. 71st Highland Lt. In.
Jervis, E. S., Lieut. H. M. 2nd Bom. Eu. Lt. Infantry.
Johnson, J. O., Lieut. 12th Regt.
Jones, E. M., Capt. 20th Regt.
Kempt, J. F., Lt.-Col. 12th Regt.
Kerr, *Lord* R. D., Lieut. and Adjt. 10th Hus.
King, G. S., *M.D.*, Surg. 14th Regt.
Lacy, G. de Lacy, Lieut. 12th Regt.
Laing, J., Lieut. 14th Regt.
Lambert, F.W., Major H. M. 56th Bengal N. I.
Lamont, J., Dep.-Lieut. Bute.
Lawrie, J. D., Lieut. 34th Regt.
Lawson, B., Major R.A.
Leach, J. G., *M.B.*, As. Surg. 94th Regt.
Leeson, C. E., Lieut. 34th Regt.
Leeson, R. J. P., Lieut. and Adjt. 34th Regt.
Le Mesurier, A. A., Capt. 14th Regt.
Levinge, *Sir* R., Bart., *M.P.*, Lt.-Col. late Westmeath Rifles.
Lewis, R., Lieut. 71st Highland Lt. In.
Lockhart, A. E., Lieut. R.E.
Lodge, W. R., Lieut. (h. p.) H. M. Indian Army
Loraine, *Sir* Lambert, Bart. Lieut. R.N.
Macauley, G.W., Capt.Com. Scinde Horse.
MacDonnell, H. I., Ens. 12th Regt.
MacDonnell, W., Capt. and Paymaster 14th Regt.
McGoun, T., Lieut. 43rd Light Infantry
Mackenzie, J. D., Capt. 14th Regt.
Mackenzie, *Sir* Wm. Dy. Lieut. Ross-shire
Mackinlay, J., Lieut. 94th Regt.
Mackinnon, W. A., Staff Surgeon.
Madden, W. W., Lieut. 8th King's.
Malthus, S., Lieut. 94th Regt.
Mapleton, H., *M.D.*, Dep. Insp. Gen. of of Hosps.
Maurice, R. M. B., Capt. 95th Regt.
Mathew, W. H., Lieut. 85th Lt. Infantry
Matthews, F. P., 1st Sussex Rifle Vol.
May, Allen, Lieut. R.E.
Mends, W. R., Capt. R.N.
Moore, F. G. F., Lieut. 8th King's.
Moore, J. L., Capt. 34th Regt.
Nangle, H., Capt. 15th Regt.
O'Brien, J. T. N., Major 20th Regt.
Palmer, J., Capt. R.N.
Peacocke, T. J., Capt. 94th Regt.
Peddie, C., Capt. 21st R. N. B. Fus.
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Staunton, L., Lieut. Hants. Mil. Art.
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The Scabbard and Sabretache of General Lefevre Desnouette, which, when taken prisoner, after throwing his sword into the river, he surrendered to Colonel Thos. Wildman, then Captain 7th Hussars, A.D.C. to the Marquis of Anglesea at the Battle of Waterloo.

The Pocket-handkerchief and Glove with which Colonel Thos. Wildman staunched the wound of the Marquis of Anglesea previous to amputation. *Mrs. Wildman.*

Russian Water Bottle or Canteen from Sevastopol. *Mr. E. Kiddle.*

Specimens illustrating the Manufacture of Gun Flints.
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One of the Iron Plates for holding together Grape Shot, found at Sevastopol in the open space in the front of the Redan.
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Clock-Watch, time of James I.
Lieut.-Colonel P. Percy Neville.

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MISCELLANEOUS.

Part of a Flag of H.M. Ship "Victory," carried in procession at Lord Nelson's funeral, which it was intended should have been lowered into his vault, but was torn up and appropriated by the sailors who carried it.
Captain W. H. Dobbie, R.N.

Flag used by the Crew of His Majesty's Ship "Niger," when they opposed the Mutineers at Sheerness in 1797, and presented by them to their Captain, Edw. James Foote.
Admiral Stanhope, in the name of his Wife.

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The Sword used by Lord Nelson when boarding the "San Joseph," off Cape St. Vincent

Vice-Admiral Sir G. R. Lambert, K.C.B.

Pistol and Officer's Dirk, taken out of "L'Intrépide," 74 guns, Captain Enfermé, which struck to the "Orion," Captain Codrington, during the action off Trafalgar.

Capt. Sir Thos. W. Holburne, Bart. R.N.

A Musket recovered in 1859 from the Wreck of "La Lutine" Frigate, 32 guns, Captain Launcelot Skynner, which frigate sailed from Yarmouth Roads for Hamburgh on the morning of the 9th October, 1799; she was lost in a heavy gale the same night, on the outer bank of the Island of Vlieland; with the exception of one man, every soul perished. *Captain Geo. Halsted, R.N.*

Sloop "Little Belt," a portion of.

Mr. J. Mann.

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OF THE

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CORRECTED TO THE

1ST JANUARY, 1861.

WHITEHALL YARD, LONDON.
[JANUARY, 1861.]

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Deputy Quartermaster-General.

Herbert, Hon. P. E. Col. C.B.

Assistant Quartermaster-Generals.

Pocklington, E. H. F. Col.
Ewart, C. B. Major R.E.

Deputy Assistant Quartermaster-General.

Ramsay, B. D. W. Major

Inspector-General of Cavalry.

Lawrenson, J. Major-Gen.

Inspector-General of Artillery.

Bloomfield, J. Major-Gen. R.A.

Inspector-General of Infantry.

Love, Sir J. F. Lieut.-Gen. K.C.B. K.H.

Assistant Adjutant-General.

Lysons, D. Col. C.B.

Attached to the Foot Guards.

Rokeby, Lord H. Major-Gen. K.C.B.

Aide-de-Camp.

Sturt, C. N. Capt. Gren. Gds.

Assistant Adjutant-General.

Hay, Lord A. Col. Gren. Gds.

Northern Division.

General Commanding.

Wetherall, Sir G. A. Lt.-Gen. K.C.B. K.H.

Commanding Royal Engineers.

Hamilton, R. G. Col. R.E.

Assistant Quartermaster-General.

Shadwell, L. Lieut.-Col.

South-Eastern Division.

Commanding Royal Artillery.

Cuppage, B. Col. R.A.

Commanding Royal Engineers.

Lennox, W. O. Lieut.-Col. R.E.

Assistant Adjutant-General.

Taylor, R. C. H. Col. C.B.

South-Western Division.

General Commanding.

Paulet, Lord W. Major-Gen. C.B.

Commanding Royal Artillery.

Dunlop, F. Col. R.A. C.B.

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Commanding Royal Engineers.
Gordon, J. W. Col. R.E. C.B.
Nugent, C. B. P. N. H. Major R.E.

Assistant Quartermaster-General.
Somerset, E. A. Col.

Assistant Adjutant-General.
Thackwell, J. E. Lieut.-Col.

Western Division.

General Commanding.
Hutchinson, W. N. Major-Gen.

Commanding Royal Artillery.
Pester, H. Col. R.A.

Commanding Royal Engineers.
Owen, H. C. C. Lieut.-Col. R.E. C.B.
Crawley, H. O. Col. R.E.

Major of Brigade.
Kirk, J. B. Capt. 96th Foot.

Town Major.
Mann, J. B. Lieut.-Col.

Chatham.

Commanding Royal Artillery.
Nedham, W. R. Col. R.A.

Major of Brigade.
Congreve, W. Capt. 4th Foot.

Woolwich.

General Commanding.
Dacres, Sir R. J. Major-Gen. R.A. K.C.B.

Aide-de-Camp.
Reilly, W. E. M. Major R.A. C.B.

Commanding Royal Engineers.
Ford, C. E. Col. R.E.

Jersey.

Lieutenant-Governor.
Douglas, R. P. Major-Gen.

Commanding Royal Artillery.
Cleaveland, F. D. Col. R.A.

The Division at Aldershot.

General Commanding.
Pennefather, Sir J. L. Lieut.-Gen. K.C.B.

Assistant Adjutant-General.
Armstrong, J. W. Col. C.B.

Deputy Assistant Quartermaster-Generals.
Young, T. Capt. 22nd Foot.
Ross, A. E. Capt. 5th Foot.

Commanding Royal Artillery.
Fitzmayer, J. W. Col. R.A. C.B.

Major of Brigade Royal Artillery.
Milman, G. H. L. Major R.A.

CAVALRY BRIGADE.

Aide-de-Camp.
Garlies, A. P. Lord, Lieut. Roy. H. Gds.

1ST INFANTRY BRIGADE.

Lawrence, A. J. Major-Gen. C.B.

Major of Brigade.
Deedes, W. Capt. 30th Foot.

2ND INFANTRY BRIGADE.

Taylor, Brook, Brigadier-Gen.

Aide-de-Camp.
Pemberton, C. P. Capt. Scot. Fus. Gds.

3RD INFANTRY BRIGADE.

Russell, D. Brigadier-Gen.

Major of Brigade.
Twynam, P. A. A. Capt. 15th Foot.

Shornecliffe Division.

Assistant Adjutant-General.
Taylor, R. C. H. Col. C.B.

1ST INFANTRY BRIGADE.

Craufurd, J. R. Major-Gen.

Aide-de-Camp.
Malet, H. C. E. Capt. Gren. Gds.

Major of Brigade.
Jones, E. M. Capt. 20th Foot.

2ND INFANTRY BRIGADE.

Brigadier-General.
Garvock, John.

Major of Brigade.
Carleton, W. H. Capt. 21st Foot.

Colchester.

Colonel on the Staff.
Gordon, Hon. Alex. Col. C.B.

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SCOTLAND.

General Commanding.

Cameron, D. A. Maj.-Gen. C.B.

Assistant Adjutant-General.

Douglas, Sir John, K.C.B. Col.

Commanding Royal Artillery.

Maclean, P. Col. R.A.

Commanding Royal Engineers.

Skyring, C. F. Col. R.E.

IRELAND.

General Commanding the Forces.

Brown, Rt. Hon. Sir Geo. Gen. G.C.B. K.H.

Aides-de-Camp.

Blackett, E. W. Capt. R. Brigade.
Maclean, F. D. Capt. 13th Dragoons.

Deputy Adjutant-General.

Brownrigg, John S. Col. C.B.

Commanding Royal Artillery.

Ormsby, J. W. Col. R.A.

Commanding Royal Engineers.

Frome, E. Col. R.E.

Aides-de-Camp to H. E. the Lord-Lieutenant.

Forster, F. R. Major 4th Dragoon Guards.
Buller, R. J. Capt. Gren. Gds.
Berger, E. A. Lieut. 10th Foot.

Dublin Division.

General Commanding Division.

Dalzell, Hon. A. A. Maj.-Gen.

Assistant Adjutant-General.

Blane, R. Col. C.B.

Assistant Quartermaster-General.

Feilding, Hon. P. R. B. Lt.-Col. Cold. Gds.

Commanding Royal Artillery.

Gambier G. Col. R.A. C.B.

CAVALRY BRIGADE.

General Commanding.

Parlby, Wm. Maj.-Gen.

Major of Brigade.

Palliser, W. Capt. 18th Lt. Dgns.

1ST INFANTRY BRIGADE.

Major of Brigade.

Daniell, C. F. T. Major.

2ND INFANTRY BRIGADE.

General Commanding.

Bloomfield, H. K. Maj.-Gen.

CURRAGH KILDARE BRIGADE.

General Commanding.

Shirley, H. Maj.-Gen. C.B.

Aide-de-Camp.

Beresford, G. R. Capt.

Assistant Quartermaster-General.

Mayow, G. W. Col.

Cork Division.

General Commanding.

Ridley, C. W. Maj.-Gen. C.B.

Aide-de-Camp.

Gascoigne, C. Capt. Gren. Gds.

EAST INDIES.

Bengal.

Aide de Camp to Governor-General.

Stanley, Hon. J. C. Capt. Gren. Gds.

Military Secretary to Commander-in-Chief.

Warre, H. J. Col. C.B.

Aide-de-Camp to Commander-in-Chief.

Rose, G. E. Capt. Rifle Brigade.

General Commanding Divisions.

Windham, C. A. Maj.-Gen. C.B.

Commanding Royal Artillery.

Barker, Sir G. R. Col. R.A. K.C.B.

Commanding Royal Engineers.

Harness, H. D. Col. R.E. C.B.

Major of Brigade.

Blane, S. J. Major 52nd Foot.

Madras.

Governor.

Denison, Sir W. T. Col. R.E. K.C.B.

General Commanding Division.

McCleverty, W. A. Maj.-Gen.

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Bombay.

Commander-in-Chief.

Mansfield, Sir W. R. Lieut.-Gen. K.C.B.

Major of Brigade.

Cleeve, S. A. Capt. 51st Foot.

AUSTRALIAN COLONIES.

Melbourne.

Major-General on the Staff.

Pratt, T. S. Maj.-Gen.

Aide-de-Camp.

Forster, B. L. Lieut. R.A.

New South Wales, Sydney.

Major of Brigade.

Heywood, W. Capt. 14th Foot.

Tasmania.

Commanding Royal Engineers.

Broughton, W. E. D. Col.

New Zealand.

Commanding Royal Engineers.

Mould, T. R. Col. R.E.

WEST INDIES.

Commanding Royal Artillery

Domville, J. W. Lieut.-Col. R.A.

Jamaica.

Lieutenant-Governor.

Taylor, Pringle, Maj.-Gen. K.H.

Deputy Adjutant-General.

Reynolds, J. W. Lieut.-Col.

Bahamas.

Governor and Commander-in-Chief.

Bayley, Chas. Jno. Esq.

Barbadoes.

Assistant Military Secretary.

Parish, Major H. W. 45th Foot.

Deputy Adjutant-General.

Hill, E. R. Col.

Commanding Royal Engineers.

Fanshawe, Chas. Lieut.-Col. R.E.

Saint Lucia.

Administering the Government.

Breen, H. H. Esq.

Dominica.

Lieutenant-Governor.

Ord, H. St. George, Lieut.-Col. R.E.

NORTH AMERICA.

Montreal.

Commanding Division.

Williams, Sir F. Bart. K.C.B. Lieut.-Gen. R.A.

Assistant Adjutant-General.

Conolly, J. Lieut.-Col.

Deputy Quartermaster-General.

Napier, G. T. C. C.B. Col.

Commanding Royal Artillery.

Eardley, Wilmot, F. M. Col. R.A.

Nova Scotia.

Aide-de-Camp.

Stapleton, F. G.

Major-General Commanding.

Trollope, C.

Aide-de-Camp.

Armstrong, C. Capt. 16th Foot.

British Columbia.

Lieutenant-Governor.

Moody, R. C. Col. R.E.

Malta.

Deputy Quartermaster-General.

Hallewell, E. G. Col.

Commanding Royal Artillery.

Warde, E. C. C.B. Col. R.A.

Major of Brigade.

Wilson, S. W. F. Capt. 55th Regt.

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Gibraltar.

Governor and Commander-in-Chief.

Codrington, Sir W. J. Lieut.-Gen. K.C.B.

Assistant Military Secretary.

Freemantle, A. J. Lieut.-Col. Colds. Gds.

Aide-de-Camp.

Campbell, Hon. H. W. Capt. Colds. Gds.

Colonel on the Staff.

Stehelin, B. S. Col. R.E.

Assistant Adjutant-General.

Lacy, T. E. Col.

Ionian Islands.

Lord High Commissioner.

Storks, Sir H. Col. K.C.B. G.C.M.G.

Aide-de-Camp.

Ponsonby, A. E. V. Capt. Gren. Gds.

Commanding Royal Artillery.

Irving, A. C.B. Col. R.A.

Cape of Good Hope.

Governor and Commander-in-Chief.

Grey, Sir George, K.C.B.

Lieutenant-Governor.

Wynyard, R. H. Lieut.-Gen. C.B.

Military Secretary.

Shipley, W. D. Capt. 58th Foot.

Colonel on the Staff.

D'Urban, W. J. Col.

Assistant Adjutant-General.

Fellowes, E. Major.

Commandants.

Freese, J. N. A. C.B. Col. R.A.
Staunton, G. Col. Cape M. Rifles.
Cobbe, C. P. Capt. 13th Foot.

Garrison Adjutant.

Gould, T. T. Lieut. 13th Foot.

WESTERN COAST OF AFRICA.

Sierra Leone.

Captain-General, and Governor-in-Chief.

Hill, S. J. Col. C.B.

Mauritius.

Major-General on the Staff.

Breton, H. W. Maj.-Gen.

Deputy Quartermaster-General.

Johnson, H. F. F. Lieut.-Col.

Commanding Royal Artillery.

Cockburn, C. V. Col. R.A.

Commanding Royal Engineers.

Burgmann, G. Col. R.E.

Ceylon.

Major-General Commanding.

O'Brien, Terence.

Assistant Quartermaster-General.

Ouvry, H. A. Lieut.-Col. C.B.

China and Hong Kong.

Commanding Division.

Michel, Sir J. Maj.-Gen. K.C.B.

Brigadier-Generals of Artillery.

Crofton, E. W. R.A. c.
Crawford, W. T. R.A. C.B. c.

Deputy Adjutant-General.

Stephenson, F.C.A. Lieut.-Col. C.B.

Deputy Quartermaster General.

Mackenzie, K. D. Lieut.-Col.

Deputy Assistant Quartermaster-General.

Brabazon, L. B. Capt. R.A.

Knights of Windsor.

Moore, C. Major
Angelo, E. A. Col. K.H.
King, J. D. Capt.

H.M. Body Guard of Yeomen of the Guard.

Captain Commanding.

Ducie, Earl.

Lieutenant.

Philipps, Sir B. T. Maj.-Gen. late Indian Army.

Exon.

Kincaid, Sir John.

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H.M. Body Guard of the Hon. Corps of Gentlemen-at-Arms.

Captain.

Foley, Rt. Hon. Lord.

Standard Bearer.

Harmar, D. J. Esq.

Gentlemen-at-Arms.

Goodwin, E. Esq.
Sutherland, E. Esq.
Middleton, W. H. Esq.
Philips, N. G. Esq.
Deane, E. P. Esq.
Vyvyan, R. H. S. Esq.

1st Life Guards.

Colonel.

Combermere, Stapleton Viscount, Field-Marshal, G.C.B. G.C.H.

Lieutenant-Colonel and Colonel.

Parker, Richard.

Major and Lieutenant-Colonel.

De Ros, Hon. D. C. FitzGerald.

Captains.

Mountcharles, G. H. Earl of.
Elmley, Henry Viscount.
Bateson, Richard H.
Wyndham, Hon. Henry.
Peyton, Algernon W.
Fraser, Jas. Keith.
Grosvenor, Hon. Robt. W.
Bruce, Lord Charles W. B.

Lieutenants.

Duncombe, Hon. Cecil.
Powerscourt, M. W. Viscount.
Patten, E. J. Wilson.
Egerton, Hon. S. J. G.
Biddulph, Richard M.
North, Hon. W. H. J.
Duncombe, C. W.
Earlsfort, J. H. R. Lord.

Cornet and Sub-Lieutenant.

Heneage, Edward.

2nd Life Guards.

Colonel.

Seaton, John Lord, Field-Marshal, G.C.B. G.C.M. G.G.C.H.

Lieutenant-Colonel.

Martyn, F. M. c.

Major and Lieutenant-Colonel.

Vyse, G. Howard.

Captains.

Ogilvy, Thos. c.
Palmer, Roger.
Berkeley, E. S. Fitzharding.

Lieutenants.

Woodgate, Francis.
Cuninghame, J. W. H.
Leyland, Thomas.
Ewart, Henry P.

Assistant-Surgeon.

Buckland, F. T.

Royal Horse Guards.

Colonel.

Gough, Hugh Viscount, General, K.P. G.C.B.

Major.

Baillie, Hugh Smith. l. c.

Captains.

Manners, Lord Geo. J. m.
Sheffield, Robt.
Baillie, Duncan Jas.
Leslie Thomas.
Williams, Bulkeley R. M. L.
Williams, O. L. C.
Hartopp, W. W.
Peach, H. Peach K.

Lieutenants.

Hill, Hon. Geoffroy, R. C.
Garlies, Alan P. Lord.
Carew, Walter P.
Bennet, Philip.
Adderley, M. B. B.
Martyn, Cecil E.

Surgeon.

Logie, Cosmo G. M.D.

1st (King's) Dragoon Guards.

Colonel.

Brotherton, Sir T. W. General, K.C.B.

Captains.

Mitchell, Thos. J.
Wadman, Art. J. P.

2nd (The Queen's) Dragoon Guards.

Lieutenant-Colonels.

Seymour, W. H. C.B.
Walker, C. P. B.

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Captain.

Steward, H. H.

Cornet.

Torrens, Robt. H.

3rd (The Prince of Wales) Dragoon Guards.

Lieutenant-Colonel.

Barron, Fenwick B.

Major.

Marah, Sir Henry, Bart.

Captain.

Francis, Thomas J.

4th (Royal Irish) Dragoon Guards.

Lieutenant-Colonel.

Bentinck, A. Cavendish c.

Captains.

Forster, Francis R. m.
Gunter, Robert.
Fisher, Edward Rowe.

5th (Princess Charlotte of Wales) Dragoon Guards.

Colonel.

Scarlett, Hon. Sir J. Yorke, Major-General, K.C.B.

Major.

Calthorpe, Hon. Somerset J. G.

Captains.

Swinfen, Frederick H.
Godman, R. Temple.

6th Dragoon Guards (Carabineers).

Captain.

Hunter, Robert Scott.

7th (The Princess Royal) Dragoon Guards.

Lieutenant-Colonel.

Thompson, Chas. W.

Captains.

Lamb, W. W.
Dowdeswell, W. F.
Blinkhorn, H.

Lieutenant.

Molyneux, Edm.

1st (Royal) Dragoons.

Colonel.

Clifton, Sir Arthur B. General, K.C.B. K.C.H.

Lieutenant-Colonel.

Wardlaw, R. c.

Major.

Ainslie, James.

Captain.

Nicholl, Hume.

2nd (Royal North British) Dragoons.

Colonel.

Kennedy, A. K. Clark, C.B. Lieut.-Gen.

Lieutenant-Colonel.

Griffith, H. Darby, C.B. c.

Major.

Clarke, G. Calvert c.

Captain.

Buchanan, Geo.

Cornet.

Hozier, John W.

3rd (King's Own) Light Dragoons.

Captain.

Bell, W. M.

4th (The Queen's Own Light) Dragoons.

Colonel.

Scovell, Sir George, General, G.C.B.

Captains.

Browne, C. A. G.
Moore, A. G. M.

Lieutenant.

Calderon, C. M.

Paymaster.

George, Thorne George m.

5th (Royal Irish Light) Dragoons (Lancers).

Colonel.

Chatterton, Sir James Charles, Lieut.-General, Bart. K.H.

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Lieutenant-Colonel.

Sulivan, G. A. F. c.

Major.

Portal, Robert.

6th (Inniskilling) Dragoons.

Colonel.

Martin, Thomas, Major-General, K.H.

Captain.

Anderson, T. E.

7th (The Queen's Own Light) Dragoons (Hussars).

Colonel.

Tuyll, Sir William, General, K.C.H.

Lieutenant-Colonel.

Russell, Sir W. Bart. C.B.

Major.

Trevelyan, Harington A.

Captain.

Aytoun, Jas.

Lieutenants.

Herbert, Hon. A. W. E. M.

8th (The King's Royal Irish Light) Dragoons (Hussars).

Colonel.

Lucan, G. C. Earl of, Lieut.-General, K.C.B.

Lieutenant-Colonel.

De Salis, Rodolph c.

Major.

Heneage, Clement W.

Captains.

Clowes, G. G. m.
Mussenden, Wm.

9th (Queen's Royal Light) Dragoons (Lancers).

Colonel.

Sleigh, Sir J. Wallace, General, K.C.B.

Major.

Steele, Aug. F. l. c.

10th (The Prince of Wales's Own Regiment of Light) Dragoons (Hussars).

Colonel.

Beauchamp, Henry B. Earl, General

Lieutenant-Colonel.

Baker, Valentine

Captain.

Bowyer, H. A.

Lieutenant.

Kerr, Lord Ralph D.

11th (Prince Albert's Own) Hussars.

Colonel.

Cardigan, Jas. T. Earl of, Major-General, K.C.B.

Captains.

Harnett, Edw.
Bingham, A. B.
Garnett, A. P.
Tempest, A. C.
Somers, R. John.

Lieutenants.

Robinson, G. C.
Mosley, Paget P.

Veterinary Surgeon.

Anthony, Paul.

12th (Prince of Wales's Royal) Lancers.

Colonel.

Lovell, Sir L. B. Lieutenant-General, K.C.B. K.H.

Lieutenant-Colonel.

Pole, Edward c.

Captain.

Cuninghame, Jno.

13th (Light) Dragoons.

Colonel.

Maclean, A. T. Major-General.

Lieutenant-Colonel.

Tremayne, Arthur.

Captain.

Maclean, Fitzroy D.

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14th (The King's Light) Dragoons.

Colonel.

Beckwith, W. Major-General, K.H.

Captain.

Blyth, W. D'Urban.

Lieutenants.

Whish, Claudius B.
Boycott, E. E. Digby.

15th (The King's Light) Dragoons (Hussars).

Colonel.

Bouverie, Everard W. Lieut.-General.

Lieutenant-Colonel.

Fitzwygram, F. W. J.

16th (Queen's) Lancers.

Colonel.

Cust, Hon. Sir Edward, Lieut.-General, K.C.H.

Captains.

Halton, Lancelot
Pigott, Fra. P.

Lieutenant.

Webster, Guy

Cornet.

Gilbard, Geo. J.

Paymaster.

Rosser, Geo. F. m.

17th (Light) Dragoons (Lancers).

Colonel.

Wallace, Sir Jas. Maxwell, Lieutenant-General, K.H.

Cornet.

Bruce, Geo. J. Brudenell. Sub-Lieut.

18th (Light) Dragoons (Hussars).

Colonel.

Byam, Edward, Lieutenant-General.

Lieutenant-Colonel.

Knox, Richard.

Captain.

Palliser, Wm.

Lieutenant.

Filgate, T. P. H. M.

Royal Artillery.

Colonels Commandants.

Tobin, Jos. Webbe. Gen.
Forbes, Thos. Jno. Gen.
Ross, Sir Hew D. G.C.B. Gen.
Turner, George, C.B. Lieut.-Gen.
Gardiner, Sir Robt. Wm. G.C.B. K.C.H. Gen.
Wallace, Peter M. Lieut.-Gen.
Jones, Richard, Lieut.-Gen.
Whinyates, Sir Edwd. Chas. K.C.B. K.H. Lieut.-Gen.
Michell, John, C.B. Lieut.-Gen.
Power, W. Greenshields, C.B. K.H. Gen.
Cobbe, George. Lieut.-Gen.
Mercer, Alex. C. Lieut.-Gen.
Colebrooke, Sir W. M. G. C.B. K.H. Lieut.-Gen.
Cator, Wm. C.B. Lieut.-Gen.
Scott, Hen. Alex. Major-Gen.

Colonels.

Pester, Henry.
Palliser, H.
Cuppage, Burke.
Burn, Robert.
Thorndike, Daniel.
Wilford, Edmd. Neal.
Wingfield, Chas. Wm.
Tulloh, Alex.
Teesdale, Hen. Geo.
Lake, Noel Thos. C.B.
Hill, John.
Morris, Hen. Jos.
St. George, J. C.B.
Nedham, Wm. Robt.
Warde, E. C. C.B.
Ormsby, John Wm.
Taylor, Arthur Jos.
Maclean, George.
Askwith, W. H.
Dunlop, Franklin, C.B.
Dick, Francis.
Dalton, Charles J.
Eardley-Wilmot, F. M.
Fitzmayor, Jas. W. C.B.
Kennedy, G. R. H.
Cockburn, Chas.

Lieutenant-Colonels.

Gambier, Gloucester, C.B. c.
Crofton, E. Walter. c.
Aylmer, Henry. c.

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Irving, Alex. C.B. c.
Browne, St. John T. c.
Freese, J. N. A. C.B. c.
Cleaveland, T. Darby. c.
Elwyn, Thomas. c.
Wright, Chas. James. c.
Maclean, Peter. c.
Crawford, Wm. T. C.B. c.
Henderson, Wm. c.
Smythe, W. James. c.
Barker, Sir G. R. K.C.B. c.
Gardner, Wm. Bethel. c.
Lefroy, John Henry. c.
Riddell, C. J. B. C.B. c.
Burrows, Arthur Geo. c.
Price, Edwd. C.B. c.
Domville, Jas. Wm. c.
Wodehouse, Edwin, C.B. c.
Maude, G. A. C.B.
Maberly, Evan, C.B.
Dixon, W. Manley Hall.
Graydon, George.
Dennis, Jas. Benjamin.
Graham, Allan H.
Younghusband, C. W.
Clerk, Henry.
Ward, Fra. B.
Mountain, Rob. F.
Inglefield, S. H. S.

Captains.

Strange, H. Fra. C.B. l. c.
Lawson, Barclay. m.
Williams, E. A. m.
Desborough, John. m.
Hamley, E. Bruce. l. c.
Strange, C. J. m.
Gleig, Alex. C.
Vesey, George Henry.
Vernon, Henry Arthur.
Milman, G. H. L. m.
Baddeley, J. F. L. m.
Smyth, Hen. A.
Phillipps, P. Winsloe.
Blosse, W. C. Lynch.
Gordon, Sam. E. l. c.
Bayly, Neville S. K.
Barstow, George. m.
Thring, John E. m.
Bent, Hugh.
Jervis, Hen. Jervis W.
Reilly, Wm. E. M. C.B. m.
Fitz-Hugh, H. T. m.
Calvert, Archd. m.
Woolsey, O'Brien B.
Drayson, Alfred Wilks.
Elgee, C. Wm.
Forbes, G. H. A.
Michell, John E. l. c.
Henry, Geo. Cecil.
Warlow, Thos. Picton.
Mainwaring, Chas. E.
Grimston, Walter John.
Addington, Hon. Leond. A.
Campbell, Patrick J.
Curtis, Reginald. m.
Bruce, Edwd. Jackson.
Hope, John Edward. m.

2nd Captains.

Miller, Fred. m.
Owen, Chas. Henry. m.
Brabazon, Luke B.
Dames, T. Longworth.
Andrews, Wm. G. m.
Noble, Andrew.
Balfour, Hen. Lowther.
Oldfield, Richard.
Strangways, W. A. F.
Yonge, W. Lambert.
Brackenbury, C. Booth.
Lyon, Francis.
Hutchinson, A. H.
Daubuz, John T.
Downes, Major F.
De Winton, Fra. Walter.
Griffiths, Leonard.

Lieutenants.

Gilmour, C. D.
Ellis, W. Burrowes E.
Franklen, Chas. Richd.
Bazalgette, Sidney Aug.
King, John Robert.
M'Laughlin, Edwd.
Staveley, Edmund.
Parsons, Lawr. H. H.
Cavendish, Jas. Chas.
Rochfort, J. de Burgh.
Forster, Bowes L.
Doull, Alex.
Stoney, Fra. Sadlier.
Tollner, Wm. Michael.
Strahan, Wm.
Sandys, Edwin Wm.
Le Grice, Fred. Swaine.
Hozier, H. M.
Ellis, C. H. Fairfax.
Lloyd, Fra. Thos.
Sladen, Joseph.
Wickham, Edm. Hill.

Chief Paymaster.

Marvin, William. m.

Paymasters.

Patterson, David A. capt.
De la Chaumette, Hen. L. capt.
Piers, C. B. capt.

Surgeons and Assisting Surgeons.

Burn, Rob. D. M.D.

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Royal Engineers.

Colonels Commandants.

Whitmore, Sir Geo. K.C.H. Gen.
Pasley, Sir Chas. W. K.C.B. Gen.
Burgoyne, Sir John F. Bart. K.C.B. Gen.
Ellicombe, C. G. C.B. Lieut.-Gen.
Oldfield, John, K.H. Lieut.-Gen.
Smith, Sir J. M. F. K.H. Lieut.-Gen.
Jones, Sir H. D. K.C.B. Lieut.-Gen.
Ward, W. Cuthbert. Lieut.-Gen.

Colonels.

Marlow, W. Biddlecomb.
Stehelin, B. Spicer.
Crawley, Henry Owen.
Walpole, John.
Frome, Edward.
Wilkinson, Chas. Edmd.
Broughton, Wm. E. D.
Burgmann, George.
Denison, Sir W. T. K.C.B.

Lieutenant-Colonels.

James, Sir Henry. c.
Robinson, William. c.
Mould, T. Rawlings. c.
Harness, H. Drury, C.B. c.
Ford, E. Twiss. c.
Yolland, William. c.
Ford, C. Erskine. c.
Moody, R. Clement. c.
Yorke, Fred. A. c.
Skyring, Charles F. c.
Hamilton, R. Gorges. c.
Gordon, John W. C.B. c.
Bainbrigge, Philip Jno.
Cameron, John.
Hawkins, John S.
Fanshawe, Charles.
Chapman, F. E. C.B. c.
Westmacott, Spencer.
Ord, H. St. George.
Simmons, J. L. A. C.B. c.
Baillie, Geo. Clement.
Collinson, T. Bernard.

Captains.

Bayly, John. m.
Owen, H. C. Cunliffe, C.B. l. c.
Jervois, Wm. F. D. m.
Keane, Hon. H. F. m.
Gibbs, Charles Jno. m.
Gosset, W. Driscoll.
Galton, Douglas.
Scott, Henry Y. D.
Ross, George.
Lovell, J. Williamson, C.B. m.
Synge, Millington H.
Ward, E. Wolstenholme.
Grant, J. M.
Fowke, Francis.
Binney, Chas. Rd.
Cooke, A. Charles. m.
Inglis, Thomas.
Hutchinson, C. Scrope.
Wray, Henry.
Pasley, Charles.
Tyler, H. Whatley.
De Butts, John, C.B.
Stace, Walter S.
Stanton, Edw. C.B. l. c.
Cheaney, C. Cornwallis.
Ewart, C. Brisbane. m.
Nugent, C. B. P. N. H. m.
Kerr, Robt. D.
Belfield, Edwd.
Wrottesley, Hon. Geo.
Porter, Whitworth. m.
Wilson, John Joshua.
Nicholson, Lothian, C.B. l. c.
Cox, Fra. Edwd.
Farrell, Sidney B.
Stotherd, R. Hugh.
Schaw, Henry.

2nd Captains.

Gordon, Geo. Hamilton.
De Vere, Fras. H. m.
Cumberland, Chas. E. m.
Creyke, Alex. S.
Lempriere, G. Reid.
Lennox, W. Oates. l. c.
Leahy, Arthur. m.
Ducane, Edmd. Fred.
Crossman, Wm.
Marsh, Willoughby D.
Cowell, J. Clayton. m.
Harvey, C. Elwin.
Philips, George.
Drake, John M. C.
James, E. Renouard.
Edwards, James B. m.
Carey, Cons. Phipps.

Lieutenants.

Trench, Hon. W. Le Poer.
Molesworth, Morgan C.
Smith, P. G. L.
Lockhart, Allen E.
Decie, Richard.
Tyler, Edwd. S.
Brooke, Edwd. Thos.
Storer, Arthur T.
Walker, Daniel C.
Home, Rob.
Locock, Herbert.
Jones, R. Owen.
May, Allen.
Parnell, Arthur.
Hamilton, Alex. C.
Crawford, Charles.
Davidson, Chas. R. T.
Salmond, William.

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Warren, Charles.
Sitwell, Honorius S.
Carroll, Wm. Joseph.
Grover, Geo. Edward.
Smith, John H.

Military Train.

Colonel Commandant.

Kennedy, J. Clarke, C.B.

Captain.

Fletcher, Thomas.

Grenadier Guards.

Colonel.

Field-Marshal His Royal Highness The Prince Consort, K.G. K.T. K.P. G.C.B. G.C.M.G.

Lieutenant-Colonel.

Lindsay, Hon. Jas. M.P. c.

Majors.

Lambert, John A. c.
Percy, Hon. H. Hugh M. c.
Wynyard, Edw. G.

Captains and Lieutenant-Colonels.

Curzon, Hon. R. W. Penn, C.B. c.
Bruce, Michael.
Conway, T. S. C.B. c.
Maitland, C. Lennox B. c.
Hay, Lord Arthur.
Montresor, Henry E.
Saxe-Weimar, H. S. Highness Prince of. c.
Stuart, Jas. F. D. C.
FitzRoy, Lord Fred. J.
Ponsonby, H. F. c.
Ellison, Cuth. G.
Cust, John Francis.
Cure, Alfred C.
King, John Hynde.
De Horsey, W. H. B.
Higginson, Geo. W. A.
Fox, Aug. H. Lane.
Randolph, Chas. W.
Cooper, Edwd. H.
Burnaby, Edwin S.
Russell, Sir C. Bart.
Hume, Henry, C.B. c.
Hogge, C. Neville.
Burrard, Sidney.
Keppel, Fred. Chas.
Barnard, W. A. M.
Alexander, Claud.
Murray, John.
Burgoyne, Sir J. Montagu, Bart.
Sturt, C. Napier.

Lieutenants and Captains

Ponsonby, A. E. V.
Verschoyle, H. W.
Bathurst, Fred. T. A. H.
Anstruther, Robert.
Hamilton, R. Wm.
Clayton, FitzRoy, A. T.
Bramston, Thos. H.
Pearson, R. L. O. m.
Ewart, W. S.
Stapleton, Fra. Geo.
Ferguson, Geo. A.
Carrick, The Earl of.
Malet, Hen. C. E.
Stanley, Hon. J. C.
Wynne, Edwd. W. L.
Earle, Wm.
Gascoigne, Clifton.
Hood, F. W. Viscount.
Stuckley, W. L.
Clive, Edwd. H.
Davies, Henry F.
Murray, Patrick K.
Tracy, Hon. J. C. G. H.
Parnell, W. H.
Lowe, R. N. C. D. m.
Thynne, Alfred W.
Smith, Philip.
Buller, Reg. J.
Pennant, Arch. C. H. D.
Phillips, Lewis Guy.
Johnstone, John Julius.
Annesley, Hon. Art.
West, Hon. W. E. Sackville.
Gould, Henry O.
Bridges, Edwd. Smith.
Edgcombe, Hon. C. E.
Melville, Norman L.
Hayter, Art. D.

Ensigns and Lieutenants.

Jarrett, Chas. B.
Byng, Alfred M.
Farmer, W. R. G.
Fairfax, Thos. F.
Nugent, Edm. C.
Norton, Rob. T. L.
Cholmeley, Hugh H.
Fludyer, Chas.
Hinchinbrook, Viscount.
Stanley, Hon. Fred. A.
Mahon, Viscount.
Uffington, W. A. F. Viscount.
Hope, Henry W.
Eliot, Hon. C. G. C.
Seymour, Leopold R.
Clinton, Henry R.

Quartermaster.

Atkinson, John.

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Battalion-Surgeon.

Nicoll, Charles R. Surgeon-Major.

Assisting Surgeons.

Lawrence, Henry J. H.
Read, C. C.

Coldstream Guards.

Colonel.

Clyde, Colin Lord, General, G.C.B.

Majors.

Newton, Wm. S. c.
Perceval, Spencer. c.

Captains and Lieutenant-Colonels.

Steele, Thos. M. C.B. c.
Wood, Wm. Mark. c.
Carleton, Dudley W.
Stepney, A. St. George H. C.B. c.
Airey, J. T. C.B. c.
Dawkins, W. Gregory.
Strong, Clem. W.
Hardinge, Hon. A. E. C.B. c.
Feilding, Hon. P. R. B.
Reeve, Wm. Hen.
Baring, Charles.
Byng, Hon. H. W. J.
Le Couteur, J. H.
Armytage, Henry.
Goodlake, G. L.
Tower, Harvey.
Dangan, W. H. Viscount.
Freemantle, Art. Jas.

Lieutenants and Captains.

Cecil, Lord E. H. B. G.
Blackett, Chas. Edward.
Boyle, Hon. W. G. m.
Conolly, John Aug. m.
Holmesdale, Viscount W. Archer.
Greenhill, Charles.
Jervoise, Henry C.
Campbell, Hon. H. W.
Hall, Julian H.
Wigram, Godfrey J.
Lambton, Arthur.
Edwardes, Hon. W.
Lane, H. J. Bagot.
Seymour, W. F. E.
Legge, Hon. Edw. Hen.
Burnell, E. S. Pegge.
Windsor-Clive, Hon. C. H. W.
Thursby, R. Hasel.
Burnand, Norman.
Wynne, Wm.
Freemantle, Fitzroy W.
Reeve, Ellis P. F.

Ensigns and Lieutenants.

Buller, Fred. C.
Bonham-Carter, H.
Fortescue, Hugh G.
Herbert, Henry Art.
Baring, Denzil H.
Lee-Mainwaring, C. W.
Hamilton, Sir E. A. Bart.

Surgeon-Major.

Monro, James, M.D.

Assisting Surgeon.

Wyatt, John.

Scots Fusilier Guards.

Colonel.

Cambridge, His Royal Highness the Duke of, General, K.G. K.P. G.C.B. G.C.M.G.

Lieutenant-Colonel.

Ridley, Wm. John. c.

Majors.

Seymour, Fred. C.B. c.
Dalrymple, J. H. Elphinstone. c.

Captains and Lieutenant-Colonels.

De Bathe, Henry P. c.
Stephenson, F. C. A. C.B. c.
Hepburn, Henry P.
Charteris, Hon. R.
Wilkinson, Henry G.
Scarlett, Hon. W. F.
Meyrick, A. W. H.
Aitchinson, Wm.
Neville, Edwd.
Gippe, Reginald.
Coke, Hon. W. C. Walpole.
Baring, Francis.
Fletcher, Henry C.
Farquharson, Jas. Ross.
White, Raymond H.
Lambton, Francis.
Mostyn, Hon. Roger.
Campbell, Arch. C.
Tottenham, Charles G.

Lieutenants and Captains.

Gordon, G. Grant.
Hay, Hon. C. Rowley.
Moncrieff, G. Hay.
Peel, Cecil L.
Jelf-Sharp, Henry.
Paynter, John.
Knox, Geo. W.
Trefusis, Hon. Walter R.
Beaumont, Godfrey W.
Cooper, Rich. A.
Erskine, Henry D.

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Rooke, Willoughby S.
Shelley, Charles.
Elphinstone, John F. B.
Palmer, Frederick.
Massey, Hon. L. E.
Pemberton, Chris. Peach.
Bowden, Hen. Geo.
Ford, James Edw.
Stephenson, Sussex V.
White, Charles Wm
Elwes, Windsor C. C.
Stracey, Henry H. D.

Ensigns and Lieutenants.

Dalzell, Rob. A.
Cunliffe, Sir Rob. A. Bart.
Smith, Gerald.
Speirs, Archd. Alex.
Tullibardine, Marquis of.

Surgeon-Major.

Bostock, J. Ashton, M.D.

Assisting Surgeons.

Elkington, Arth. G.
Baker, Francis B.
Turner, Henry.

1st (The Royals) Regiment.

Colonel.

Blakeney, General, Right Hon. Sir Edw. G.C.B. G.C.H.

Ensign.

Atkinson, Thos. 1st

2nd (Queen's Royals).

Colonel.

Spink, John, Lieut.-Gen. K.H.

Lieutenant-Colonel.

Bruce, Robert. 2nd

Majors.

Addison, Thomas. l. c. 1st
Gibbs, Charles.

Lieutenants.

Turnor, George, 2nd

Ensign.

Twyford, A. F.

Paymaster.

Simpson, R. H.

3rd (The Buffs).

Colonel.

Grey, Hon. Charles, Major-General.

Major.

King, H. J. 1st

Captains.

Pearson, C. K. 2nd
Cowell, H. R. 2nd

4th (King's Own).

Colonel.

Bell, Sir John, General, G.C.B.

Majors.

Cameron, W. G. 1st
Cocks, O. Y. 2nd

Captain.

Congreve, Wm. 2nd

Lieutenant.

Chinn, E. 2nd

5th (Northumberland) Fusiliers.

Colonel.

Walton, Wm. Lovelace, Lieutenant-General.

Lieutenant-Colonels.

Guy, P. M. N. C.B. c. 1st
Kirkland, J. A. V. 2nd

Major.

Bartley, J. C. 2nd

Captains.

Pender, Fra. H. 1st
Adair, J. W. Dunlop 2nd
Ross, A. E. 2nd
Walpole, Horatio 1st

6th (Royal First Warwickshire).

Colonel.

Riddell, K. H.
James, Henry, General.

Lieutenant-Colonel.

Robertson, J. E. 1st

Captains.

Black, Wilsone 2nd
Lawrell, Hen. John 1st

Ensign.

Blair, J. B. 2nd

7th (Royal Fusiliers).

Colonel.

Auchmuty, Sir Samuel Benjn. General, K.C.B.

Major.

Watson, Charles E. 1st

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Captains.

Waller, Geo. Henry 1st
Daubeny, A. G. 2nd

Lieutenant.

Frampton, Wm. John 1st

8th (The King's Regiment).

Colonel.

Monins, Eaton, Major-General.

Lieutenant-Colonels.

Wilson, T. M. c. 2nd
Haines, F. P. c. 1st

Major.

Robertson, Alex. C. l. c. 1st

Captains.

Beere, D. 2nd
Dyer, H. S. 2nd
Bruce, R. C. D. 2nd
Dugmore, W. F. J. 1st
Tanner, Edward 2nd

Lieutenants.

Brown, C. B. 2nd
Moore, F. G. Furlong 2nd
Wheeley, J. S. 2nd
Aylmer, J. E. F. 2nd
Madden, W. W. 1st

Ensigns.

Skinner, Theodore H. 2nd

9th (The East Norfolk).

Captains.

Darling, S. m. 1st
Scott, H. Bassett. m. 1st
Gammell, John H. H. 1st

10th (North Lincoln).

Lieutenant-Colonel.

Longden, H. E. C.B. c. 1st

Lieutenant.

Berger, Ernest A. 2nd

11th (North Devon).

Colonel.

Doherty, Sir Richard, Lieut.-General.

Captain.

Philpot, Philip 1st

Lieutenant.

Hare, Edward Henry. 2nd

12th (East Suffolk).

Colonel.

Bentinck, C. A. F. Lieut.-General.

Major.

Kempt, J. Francis 1st

Captains.

Espinasse, J. W. 2nd
Dundas, Thos. 2nd
Wilkie, John L. 1st
Fitzgerald, F. A. 1st

Lieutenants.

Lacy, G. de L. 2nd
Johnson, J. O. 2nd
Dunlevie, Wm. S. Henry 2nd
MacDonnell, H. J. 2nd

13th (Prince Albert's) Light Infantry.

Colonel.

Gomm, Sir Wm. Maynard, General, G.C.B.

Lieutenant-Colonels.

Kerr, Lord Mark, C.B. c. 1st
King, George 1st

Captains.

Long, C. P. 1st
Cobbe, C. P. 2nd

Lieutenant.

Gould, T. T. 2nd

Surgeon.

Ligertwood, T. M.B. 1st

14th (Buckinghamshire).

Colonel.

Watson, Sir James, General, K.C.B.

Lieutenant-Colonels.

Budd, Ralph 1st
Alexander, Sir J. E. c. 2nd

Majors.

Trevor, Wm. C. 1st
Holworthy, Edw. J. 1st

Captains.

Hammersley, F. m. 1st
Grogan, Chas. Edw. 1st
Maycock, John G. 1st
Petrie, Martin 1st
Cosby, Thos. P. 1st
Heywood, Wm. 2nd
Le Mesurier, And. A. 1st
Mackenzie, J. D. 2nd
Gleig, C. E. S. m. 1st

Lieutenants.

Costin, Charles 1st
Burton, Henry A. 1st
Laing, Joseph 1st

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Ensigns.

Williams, Henry A. 1st
Hutchison, Henry M'L. 1st

Paymaster.

Macdonnell, Wm. 1st

Surgeons.

King, G. S. M.D. 1st

15th (York, East Riding).

Colonel.

Douglas, Sir Howard, Bart. General, G.C.B. G.C.M.G.

Lieutenant-Colonel.

Cole, John A. 1st

Captains.

Twynam, P. A. A. 1st
Oldfield, Aldred 2nd
Nangle, Henry 1st

Lieutenant.

Layard, Chas. E. 2nd

16th (Bedfordshire).

Colonel.

Berkeley, Sacville H. General.

Lieutenant-Colonel.

Peacocke, Geo. John. 1st

Major.

De Winton, C. L. 2nd

Captains.

Armstrong, Chas. 1st
Lombard, G. C. S. 2nd

Lieutenant.

Kelsall, Henry 2nd

17th (Leicestershire).

Colonel.

Airey, Sir Richard, Major-General, K.C.B.

Major.

Colthrust, D. Latouche. 2nd

Lieutenant.

Perceval, John J. 2nd

18th (Royal Irish).

Lieutenant-Colonel.

Grant, John Thornton. C.B. c. 1st

Major.

Carey, G. J. c. 2nd

Captains.

Pocklington, Geo. H. 1st
Havelock, Sir Henry M. Bart. l. c. 2nd
Baker, Thos. D. 2nd
Vickars, H. G. A. 2nd

19th (1st York, North Riding).

Colonel.

Rowan, Sir W. Lieut.-Gen. K.C.B.

Lieutenant-Colonels.

Mundy, Geo. V. C.B. c. 1st
Bright, Robt. O. 1st
Warden, Robert. 2nd

Major.

Graham, Lumley. l. c. 2nd

Lieutenant.

Browne, H. John. 1st

20th (East Devonshire).

Captains.

O'Brien, J. T. N. m. 1st
Jones, E. Monckton. 2nd

21st (Royal North British Fusiliers).

Colonel.

Evans, Sir De Lacy, Lieut.-Gen. G.C.B.

Major.

Steward, E. A. T. 2nd

Captains.

Peddie, Crofton. 1st
Templeman, Alfred. 2nd
Sheffield, John Charles. 1st
Carleton, Wm. Henry. 2nd
Cairnes, W. 1st
Hollway, T. Burchell. 1st
Holt, Alfred. 1st

Lieutenant.

Winslow, Richd. W. C. 1st

Quartermaster.

Grahame, Geo. 1st

22nd (The Cheshire).

Colonel.

Pennefather, Sir J. L. Lieut.-Gen. K.C.B.

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Lieutenant-Colonel.

Harding, F. Pym, C.B. c. 1st
Anderson, David. 2nd

Majors.

Robinson, Sir G. A. Bart. 1st
Bowden, Herbert Geo. 2nd

Captains.

Young, Thomas. 1st
Molony, W. M. 2nd
M'Bean, William 1st
Thursby, James L. 1st
Swann, John S. 2nd

23rd (Royal Welsh Fusiliers).

Colonel.

Codrington, Sir Wm. J. Lieut.-Gen. K.C.B.

Lieutenant-Colonel.

Pratt, Robert, C.B. 1st

Majors.

Bulwer, E. G. C.B. l. c. 2nd
Gubbins, James. 2nd
Torrens, Henry D. l. c. 1st

Captains.

Granville, Bevill. m. 2nd
Reid, David 2nd
Blane, Charles G. 2nd
Armstrong, Edw. 2nd

Lieutenants.

Bussell, G. W. H. 2nd
Hutton, Fred. Wm. 2nd
Walwyn, Jas. H. 2nd
Lewis, Geo. Wm. 2nd
Molyneux, A. M. 1st

Assistant-Surgeon.

Berkeley, R. W. 2nd

24th (2nd Warwickshire).

Colonel.

Finch, Hon. J. Lieut.-Gen. C.B.

Captains.

Clark, Thomas. 2nd
Godwin-Austen, H. H. 1st

Lieutenant.

Plasket, W. A. H. 2nd

25th (The King's Own Borderers).

Paymaster.

Brumell, Wm. m.

26th (Cameronians).

Colonel.

Bainbrigge, Sir Philip, Lieut. Gen. K.C.B.

Captain.

Lockhart, Wm. E.

Ensign.

Buchanan, Jas. R. G.

27th (Inniskilling).

Colonel.

Geddes, John, Major-General, K.H.

28th (North Gloucestershire).

Colonel.

Bentinck, Sir. Hen. J. W. Lieut.-Gen. K.C.B.

29th (Worcestershire).

Colonel.

Downes, Ulysses, Lord, General, G.C.B.

30th (Cambridgeshire).

Colonel.

Tweeddale, George, Marquis of, General, K.T. C.B.

Captain.

Deedes, Wm.

Paymaster.

Lamert, G. F.

31st (Huntingdonshire).

Colonel.

Craigie, P. E. Lieut.-Gen. C.B.

Lieutenant-Colonel.

Sutton, Wm. c.

Major.

Swaffield, C. J. O.

Captain.

Mitchell, Alex.

Lieutenant.

Pepper, Geo. N.

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32nd (Cornwall Light Infantry).

Colonel.

Inglis, Sir John E. W. Maj.-Gen. K.C.B.

Lieutenant-Colonel.

Stapylton, G. G. C.

Captain.

Colls, Robt. Stacy. m.

33rd (The Duke of Wellington's Regiment).

Colonel.

York, Sir Charles, Lieut.-Gen. G.C.B.

Lieutenant-Colonel.

Collings, John E.

Major.

FitzGerald, Henry C.

Captain.

Vacher, F. S. m.

34th (Cumberland).

Colonel.

Eden, John, Maj.-Gen. C.B.

Major.

Maxwell, James.

Captains.

Marsh, Edward H.
Chapman, Art. T. L.
Boyce, Abel W.
Moore, J. Leslie.
Saunders, T. Harry.

Lieutenants.

Dunbar, Wm. M.
Laurie, Julius D.
Leeson, R. J. P. Adjt.
Leeson, C. E.

Ensign.

Webb, C. H.

35th (Royal Sussex).

Lieutenant.

Lloyd, Thos.

36th (Herefordshire).

Colonel.

Scott, Wm. Henry, Lieut.-Gen.

Lieutenant-Colonel.

Hort, John J.

Captain.

Twyford, Henry R.

Lieutenant.

Powys, Hon. C. J. Fox.

37th (North Hampshire).

Colonel.

Fraser, John, Lieut.-Gen.

Captains.

Heaton, John R. l. c.
Ind, Fred. J. Nash.

Lieutenant.

Bunn, Richard.

38th (1st Staffordshire).

Colonel.

Arbuthnott, Hon. Hugh, General, C.B.

Lieutenant-Colonels.

Sparks, J. P. C.B. c.
Haly, W. O'Grady, C.B. c.

39th (Dorsetshire).

Nil.

40th (2nd Somersetshire).

Colonel.

Woodford, Sir Alexander, General, G.C.B. G.C.M.G.

Lieutenant-Colonel.

Leslie, Arthur.

41st (The Welsh).

Colonel.

A'Court, Repington, C. Ashe, General, C.B. K.H.

Captain.

Bertram, C. P. m.

42nd (Royal Highlanders).

Nil.

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43rd (Monmouthshire Light Infantry).

Colonel.

Fergusson, Sir James, General, G.C.B.

Captain.

Glover, Robert Coke.

Lieutenants.

Glover, F. G. E.
M'Goun, Thos.

Ensigns.

Villiers, Ernest.
Hogarth, Joseph.
Salmon, Chas.

Paymaster.

Morgan, Horatio.

44th (East Essex).

Colonel.

Reed, Thos. Lieut.-General, C.B.

Major.

Hackett, John.

45th (Nottinghamshire).

Lieutenant-Colonel.

Cooper, Henry. c.

Captains.

Parish, H. Wood. m.
Wood, J. J.

Lieutenants.

Webber, Fred. W. S.
Hayward, Henry B.

Ensigns.

Hooke, Henry H.
Hancock, Hen. J. B.
De Thoren, Oscar W.

Paymaster.

Blythe, John D.

46th (South Devon).

Nil.

47th (The Lancashire).

Majors.

Lowry, Rob. Wm. l. c.
Lodder, Hen. Call.

48th (Northamptonshire).

Lieutenant-Colonels.

Riky, Benjamin. c.
Campbell, A. Neil.

49th (The Princess Charlotte of Wales's).

Colonel.

Bowater, Sir Edward, General, K.C.H.

Lieutenant-Colonel.

Edwards, Clement A. C.B. c.

Captain.

Gibson, C. E.

Lieutenant.

Eustace, Thos. Fox.

50th (Queen's Own).

Colonel.

England, Sir Richard, Lieut.-General, G.C.B. K.H.

Captain.

Lock, A. C. K. m.

Lieutenant.

Goff, Rob. Chas.

51st (The King's Own) Light Infantry.

Lieutenant-Colonels.

Errington, Arnold C.
Irby, Aug. H.

Captain.

Cleeve, Stewart A.

Ensign.

Robertson, Geo. S.

52nd (Oxfordshire) Light Infantry.

Major.

Peel, Art. Lennox.
Bourchier, Jas. Johnes.

Captains.

Curzon, Hon. Ernest G.
Monson, Hon. D. J.
Blane, Seymour J. m.
Adair, Alex. W.

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Lieutenants.

Cowburn, Thos. B.
Adair, Henry A.

53rd (The Shropshire).

Colonel.

Maunsell, Fred. Major-General.

54th (West Norfolk).

Colonel.

Fane, Mildmay, Lieut.-General.

Lieutenant.

Bayly, Vere Temple.

55th (Westmoreland).

Colonel.

Schoedde, Sir James Holmes, Lieut.-General, K.C.B.

Captains.

Wilson, S. W. F.
Bellamy, Percy L.

56th (West Essex).

Colonel.

Breton, H. Wm. Major-General.

Lieutenant.

Thompson, Robt. T.

Ensign.

Heyland, Art. Rowley.

57th (West Middlesex).

Colonel.

Love, Sir Jas. Fred. Lieut.-General, K.C.B. K.H.

Lieutenant-Colonels.

Warre, Henry J. C.B. c.
Inglis, Wm.

Lieutenant.

Clarke, Chas. M.

Ensign.

Manners, Art. C.

58th (Rutlandshire).

Colonel.

Wynyard, Edw. Buckley, General, C.B.

Lieutenant-Colonel.

Bridge, Cyprian.

Captains.

Shipley, Wm. D.
Hall, Angus W.
Horner, John.

Ensign.

Butler, Henry Thomas.

59th (2nd Nottinghamshire).

Colonel.

Taylor, Jer. Lieut.-General.

60th (The King's Royal) Rifle Corps.

Colonel-in-Chief.

Gough, Hugh, Viscount, General, K.P. G.C.B.

Colonel-Commandant.

Moore, Sir W. G. Lieut.-Gen. K.C.B.

Lieutenant-Colonel.

Jones, Sir J. K.C.B. c. 1st

Majors.

North, C. N. l. c. 1st
Feilden, R. Joseph. 4th

Captains.

Battersby, J. P. 3rd
Churchill, C. H. S. m. 3rd
Travers, Fras. S. 4th

Lieutenants.

Morrah, James Art. 2nd
Moseley, W. H. 2nd

61st (South Gloucestershire).

Colonel.

Reeve, John, General.

Major.

Redmond, J. Pat.

Lieutenant.

Yonge, Henry John.

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62nd (The Wiltshire).

Colonel.

Knollys, Wm. T. Lieut.-General.

Lieutenant-Colonel.

Ingal, Lenox W. C.B. c.

Major.

Daubeny, James, C.B. l. c.

Captains.

Wilkieson, Geo. H.
Hay, Graham.

Lieutenant.

Grant, George Fox.

63rd (The West Suffolk).

Colonel.

Kenah, Thomas, General, C.B.

Major.

Grey, Fra. D.

Captain.

Paterson, F. T. L.

Lieutenants.

Clutterbuck, Geo. W.
Crowther, R. W. B.
Boyd, James P.

Ensigns.

Smyth, James S.
Atkinson, Thos.
Scovell, Thornton.

64th (2nd Staffordshire).

Colonel.

Freeth, James, Lieut.-General, K.H.

Lieutenant-Colonel.

Bingham, G. W. P. C.B.

Major.

Anderson, Thomas.

65th (2nd Yorkshire, North Riding).

Captain.

Blewitt, Charles.

66th (Berkshire).

Captain.

Walker, John.

67th (South Hampshire).

Colonel.

Davies, Fra. J. Lieut.-General.

Lieutenant-Colonel.

Knox, Thos. Edmd.

Major.

Porter, John.

Captains.

Thompson, Daniel.
Jebb, Fred. Wm.

68th (The Durham) Light Infantry.

Lieutenant-Colonel.

Greer, H. Harpur.

Major.

Morant, H. H.

Captains.

Fitzroy, Cavendish C.
Oakley, G. J. A.

69th (South Lincolnshire).

Colonel.

Gascoigne, Ernest F. Lieut.-General.

Lieutenant-Colonel.

Mackirdy, Dav. E. c.

Captains.

Charleton, T. H.
Leggett, Robt. A.

70th (The Surrey).

Colonel.

Paty, Geo. Wm. Lieut.-General, C.B. K.H.

Lieutenant-Colonel.

Galloway, Thos. James.

Assisting-Surgeon.

Alston, W. E. M.D.

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71st (Highland) Light Infantry.

Lieutenant-Colonels.

Hope, William, C.B.
Rich, George W. T.

Major.

Gore, James Art.

Captain.

Mounsey, Chas. J.

Lieutenants.

Lewis, Robert.
Isacke, R. J.
Leslie, John Henry.

72nd (Highlanders).

Colonel.

Aitchison, Sir John, General, K.C.B.

Major.

Norman, C. J. W.

Surgeon.

Seaman, W. C. M.D.

73rd Regiment.

Majors.

Jones, Hugh M.
Bewes, W. E. l. c.

Captains.

O'Brien, W. Creagh.
Reeve, Frederick.
Henslowe, Spencer V. F.

Ensign.

Turner, J. T.

74th (Highlanders).

Colonel.

Shawe, Chas. A. Lieut.-General.

Captain.

Dormer, Hon. J. B. J.

75th Regiment.

Colonel.

Clerke, St. John A. Lieut.-General, K.H.

76th Regiment.

Colonel.

Jervois, William, General, K.H.

Lieutenant-Colonel.

Smyth, Henry, C.B. c.

Major.

Dennis, M. S. T.

77th (East Middlesex).

Lieutenant-Colonels.

Chichester, Hon. A. G. C.
Deverell, Thos. J. c.

78th (Highlanders).

Lieutenants.

Barker, George D.
Ingles, Hen. A.

79th (Cameron Highlanders).

Lieutenant-Colonel.

Butt, Thos. B.

Captains.

Scovell, G. T.
Harrison, G. A.

80th (Staffordshire Volunteers).

Colonel.

Robbins, T. W. Lieut.-General.

81st (Loyal Lincoln Volunteers).

Colonel.

Evans, Thomas, General, C.B.

Lieutenant-Colonel.

Renny, Henry. c.

82nd (The Prince of Wales's Volunteers).

Colonel.

Ashburnham, Hon. Thos. Lieut.-Gen. C.B.

Captain.

Marriott, Henry C. m.

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Lieutenant.

East, Cecil J.

Ensign.

Marchant, C. H.

83rd (County of Dublin).

Colonel.

Stovin, Sir Fred. General, G.C.B. K.C.M.G.

Lieutenant.

Brymer, James E.

84th (York and Lancaster).

Colonel.

Wetherall, Sir Geo. A. Lt.-Gen. K.C.B. K.H.

85th (The King's Light Infantry).

Colonel.

Guise, Sir John W. Bart. General, K.C.B.

Captain.

Baker, Wm. Thos.

Lieutenant.

Mathew, W. H.

86th (Royal County Down).

Nil.

87th (Royal Irish Fusiliers).

Colonel.

Simpson, Sir James, General, G.C.B.

Major.

Hamilton, L. H.

88th (Connaught Rangers).

Captain.

Crosse, Jos. Grant. m.

89th Regiment.

Nil.

90th (Light Infantry).

Colonel.

Macintosh, A. Fisher, Lieut.-General, K.H.

Captain.

Gale, Hen. R. H.

Lieutenant.

Haig, J. F

91st (Argyllshire).

Colonel.

Gore, Hon. Sir Charles, Lieutenant-General, K.C.B. K.H.

Lieutenant-Colonel.

Patterson, W. T. L.

Captains.

Sweny, J. C.
Dewell, Chas. G.
D'Eye, W. Rust.

Lieutenants.

Spearman, Horace R.
Harvey, Chas. L.

92nd (Highlanders).

Lieutenant-Colonel.

Lockhart, A. Inglis, C.B. c.

Major.

Mackenzie, K. D. l. c.

93rd (Highlanders).

Colonel.

Sutherland, Wm. Lieut.-General, C.B.

Captains.

Burroughs, F. W. m.
Knollys, W. W.

Lieutenant.

Tabateau, A. O.

94th Regiment.

Colonel.

Higginson, G. P. Lieut.-General.

Lieutenant-Colonel.

Mills, C. J. c.

Captains.

Cafe, Haydon L.
Peacocke, T. G.
Elliot, A. C.
Elliot, F. H.

Lieutenants.

Malthus, Sydney, Adjutant.
Teevan, G. J.
Steuart, Ramsay.
Anstruther, F. R.
Pilkington, J. B.
Mackinlay, J.

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Ensign.

Buller, W. G.

Paymaster.

Wahab, H. J.

Assistant-Surgeon.

Leask, J. G. M.B.

95th (The Derbyshire).

Colonel.

Cockburn, Sir Francis, General.

Lieutenant-Colonels.

Raines, Julius A. R. C.B. c.
Thesiger, Hon. F. A.

Captains.

Carmichael, Geo. L. m.
Maurice, R. M. B.

Lieutenant.

Chapple, E.

Surgeon.

Gibbons, John.

96th Regiment.

Lieutenant-Colonel.

Scovell, Edw. W.

Captain.

Kirk, James B.

97th (Earl of Ulster's).

Colonel.

Morris, Edm. F. Lieut.-General, C.B.

Lieutenant.

FitzGerald, M. G. B.

98th Regiment.

Colonel.

Darling, Wm. Lindsay, Lieut.-General.

Lieutenant-Colonels.

Rainier, Daniel. c.
Bates, Henry. c.

Major.

Peyton, Francis.

Captain.

Crawford, Francis H.

Lieutenant.

Gardiner, Thomas.

99th (Lanarkshire).

Majors.

Dowbiggin, M. H.
Blamire, Charles.

100th (Prince of Wales Royal Canadians) Regiment.

Colonel.

Melville, Henry Viscount, Lieut.-General, K.C.B.

Captains.

Cook, Henry.
Slade, A. F. A.

Ensign.

Ashford, Henry Wm.

Rifle Brigade.

Colonel-Commandant.

Brown, Right Hon. Sir Geo. General, G.C.B. K.H.

Lieutenant-Colonels.

Elrington, F. R.	4th
Hardinge, Henry.	3rd

Majors.

Newdegate, Edwd.	4th
Elliot, Hon. G.	4th
Walker, Hercules.	2nd

Captains.

Bourchier, Claude T. m.	3rd
Blackett, Edwd. W.	4th
Hill, Horace F.	3rd
Maclean, H. J.	1st
Milles, Hon. L. W. m.	2nd
Rose, Geo. E.	3rd
Moore, John Croft.	4th
Clerk, John.	2nd
Coulson, John B. B.	2nd
Harington, R. E. Stuart.	1st
Wood, Henry.	3rd
Seymour, F. H. A.	2nd

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Lieutenants.

Stade, Charles Geo. 1st
Blundell, H. B. H. 1st
Green, Andrew. 3rd
Mildmay, H. A. St. J. 4th
Ramsbottom, F. W. 2nd

Ensign.

Turnor, Chris. H. 4th

1st West India Regiment.

Colonel.

Bowles, Sir George, General, K.C.B.

Lieutenant-Colonel.

O'Connor, L. S. C.B. c.

2nd West India Regiment.

Colonel.

Frith, John W. Major-General.

Lieutenant-Colonels.

Whitfeild, Henry W. c.
Gibbings, Thomas.

Major.

Hill, William.

3rd West India Regiment.

Colonel.

Wood, William, General, C.B. K.H.

Ensign.

Hincks, Alex. Stewart.

Quarter-Master.

Doorly, Martin.

Ceylon Rifle Regiment.

Captain.

Meaden, James.

Ensign.

Baldwin, Fred. C.

Cape Mounted Riflemen.

Lieutenant-Colonel.

Staunton, George. c.

Captain.

Pole, Chas. Van Notten.

Lieutenant.

Brabant, Edw. Yewd.

Ensigns.

Hay, T. H. V. D.
Marillier, Chas. H.
Pote, C. St. Clare.

Royal Canadian Rifle Regiment.

Lieutenant-Colonel.

Braford, W. H. c.

Captain.

Grange, Chas. W. m.

Royal Newfoundland Companies.

Major.

Grant, John James.

DEPOTS AND DEPOT BATTALIONS.

Invalid Depot, Chatham.

Staff Captain.

De Teissier, J. F. l. c.

School of Musketry, Hythe.

Commandant and Inspector-General.

Hay, C. C. Major-General.

Cavalry Depot, Maidstone.

Commandant.

Gibsone, J. C. H. c.

Assistant-Commandant.

Teusch-Hecker, C.H. Lieut.-Col.

Cavalry Depot, Canterbury.

Major.

Tomkinson, Edwd.

2nd Depot Battalion, Chatham.

Commandant.

Phillips, R. Newton. c.

Major.

Stewart, W. L. l. c.

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5th Depot Battalion, Isle of Wight.

Lieutenant-Colonel.

Jeffreys, E. R. C.B. c.

Major.

Tritton, F. B.

6th Depot Battalion, Walmer.

Paymaster.

Burney, H. S. S. m.

7th Depot Battalion, Winchester.

Lieutenant-Colonel.

M'Donald, A. M.

Major.

Wombwell, Art.

10th Depot Battalion, Colchester.

Instructor of Musketry.

Chapman, Capt. A. T. L.

11th Depot Battalion, Preston.

Major.

Skipwith, Geo.

12th Depot Battalion, Athlone.

Major.

Nason, J.

Paymaster.

Benson, G. T. m.

15th Depot Battalion, Buttevant.

Staff Surgeon.

Clarke, John. M.D.

16th Depot Battalion, Templemore.

Major.

Charter, E. J.

17th Depot Battalion, Limerick.

Lieutenant-Colonel.

Borton, Arthur, C.B. c.

Major.

Yonge, G. N. K. A.

Paymaster.

Fair, Alex.

18th Depot Battalion, Fermoy.

Lieutenant-Colonel.

Egerton, C. R.

19th Depot Battalion, Fermoy.

Major.

Chichester, Chas. R.

21st Depot Battalion, Chichester.

Lieutenant-Colonel.

Wright, E. W. C.

22nd Depot Battalion, Stirling.

Paymaster.

Hall, John Peter.

Convalescent Establishment, Yarmouth.

Commandant.

Jervois, Captain E. S.

Paymaster.

Naylor, S. m.

RECRUITING STAFF.

Bristol.

Sullivan, Col. Wm. C.B. I.F.O.

Superintendent Officer.

Bussell, Lieut. G. W. H. 23rd Fus.

London.

Superintendent Officer.

Fitzgerald, Lieut. M. G. B. 97th Foot.

Glasgow.

Superintendent Officer.

Browne, H. J. Lieut. 19th Foot.

Dublin.

Brooke, E. B. Col. I.F.O.

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Cork.

Gardiner, R. Col. I.F.O.

Paymaster.

Fitzgerald, W. H. Major.

Royal Engineers.

Crawley, H. O. Col. Exeter.
Stotherd, R. H. Capt. Edinburgh.

STAFF OFFICERS OF PENSIONERS.

Superintendent.

Tulloch, Sir A. M. Major-Gen.

Assisting Superintendent.

Crofton, John, Col.

Edinburgh.

Hope, F. Col.

Glasgow.

Campbell, Walter, Col.

Hull.

Teale, C. S. Lieut.-Col.

Ipswich.

Capel, S. A. Major.

London.

Campbell, G. H. F. Col.
O'Brien, R. S. Major.
M'Nair, R. Capt.
Graham, J. J. Col.
Christie, F. G. Major.

Plymouth.

Russell, H. Lieut.-Col.

Limerick.

Bayly, Geo. Major.

Sunderland.

Parkinson, C. F. Col.

Commissariat Department.

Deputy Commissary Generals.

Morse, H. B.
Carpenter, F. S.
Power, W. J. T. C.B.

Assisting Commissary Generals.

Strickland, Edward
Salwey, A.
De Fonblanque, E. B.

Deputy Assisting Commissary Generals.

Cookesley, A. F.

Medical Department.

Director General.

Gibson, J. B. M.D. C.B.

Inspector Generals.

Logan, T. G. M.D.
Williams. J. E.

Deputy Inspector Generals.

Lawson, Robert.
M'Ilree, John D.
Longmore, Thos.
O'Flaherty, R. J.
Balfour, T. G. M.D.
Mapleton, H. M.D.
Maclachlan, D. M.D.

Staff Surgeon Majors.

Anderson, Geo.
Webster, G. M. M.D.

Staff Surgeons.

Docker, E. S.
Smith, H. F. M.D.
Clarke, J. M.D.

Purveyors Department.

Purveyor.

Harrington, S. C.

Chaplains' Department.

Chaplain General.

Gleig, Rev. G. R. M.A.

Chaplains to the Forces.

Browne, R. W.
Sykes, W. Cape of Good Hope.

Barrack Master.

Sutherland, E. Major.	Woolwich.
White, L. Major.	London.
Sanders, G. H. Lieut.	Parkhurst.

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Royal Marines, Light Infantry.

Colonel Commandant.

Rea, Edwd.

2nd Commandants.

Lemon, Thos. C.B.
Moore, T. C. C.

Lieutenant-Colonels.

Langley, Geo. Colt. c.
Travers, Jos. Oates.
March, W. H.

Captain.

Fellowes, P. H.

Lieutenant.

Shanks, Jos. Geo.

Deputy Adjutant General.

Wesley, S. R. Maj.-Gen.

WAR OFFICE (Pall Mall).

Secretary of State.

Herbert, the Right Hon. Sidney, M.P.

Under Secretary of State.

De Grey and Ripon, Earl.
Lugard, Sir E. Maj.-Gen. K.C.B.

Inspector General of Fortifications.

Burgoyne, Sir John, Gen. G.C.B.

Deputy Inspector General of Fortifications.

Foster, Thos. Maj.-Gen.

Assisting Inspectors General of Fortifications.

Jervois, W. F. D. Major.
Belfield, E. Capt.
Galton, D. Capt.

Inspector General of Militia.

Paulet, Lord F. Col. C.B.

Inspector General of Volunteers.

M'Murdo, W. M. S. Col. C.B.

Engineer for Rifled Ordnance.

Armstrong, Sir W. Geo. C.B.

Director of Stores and Clothing.

Caffin, J. C. Capt. R.N.

Assistant Accountant-General.

Whiffin, H. W. S. Esq.

Topographical Department.

Director.

James, Sir Hen. Col. R.E.

Executive Officer.

Cooke, A. C. Major R.E.

Assistant.

Petrie, M. Capt. 14th Foot

Ordnance Select Committee.

President.

St. George, J. Col. C.B. R.A.

Vice President.

Wiseman, Sir W. Bart. R.N.

Members.

Robinson, W. Col. R.E.
Greathed, E. H. Col. C.B.

Secretary.

Lefroy, J. H. Col. R.A.

Woolwich.

Superintendent Royal Carriage Department.

Tulloh, Col. Alex. R.A.

Superintendent of Gun Factories.

Armstrong, Sir W. G. C.B.

Enfield.

Superintendent of Small Arm Factories.

Dixon, W. M. H. Lieut.-Col. R.A.

Waltham Abbey.

Askwith, W. H. Col. R.A.

Council of Education.

Vice-President.

Rumley, Randel.

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Members.

Portlock, J. E. Maj.-Gen. R.E.
Addison, J. E. Lieut.-Col.
Elwyn, Thos. Col. R.A.

Military Prison.

Inspector-General.

Jebb, Sir Joshua, Maj.-Gen. K.C.B.

Dublin.

Governor.

Rutherford, J. H. Major.

Royal Military College at Sandhurst.

Governor.

Jones, Sir Harry D. Gen. K.C.B. R.E.

Cadets' College.

Superintendent of Studies.

Napier, W. C. E. Col.

PROFESSORS AND MASTERS.

Fortifications.

Adams, W. H. Col.
Griffiths, L. Capt. R.A.
Doull, A. Lieut. R.A.

Military Surveying.

Petley, E. Major.

Military Drawing.

Paterson, Wm. Capt.

Military History.

Chesney, C. C. Capt. R.E.

Staff College.

Commandant.

Macdougall, P. L. Col.

PROFESSORS AND MASTERS.

Military History.

Hamley, E. B. Lieut.-Col. R.A.

Fortifications and Artillery.

Mainwaring, C. E. Capt. R.A.

Military Topography.

Farrell, S. B. Capt. R.E.

Military Administration.

Walker, W. Capt.

East Indian Military College at Addiscombe.

Lieutenant-Governor.

Abbott, Sir F. Major-Gen. C.B.

Staff Officer.

Donnelly, T. Lieut.-Col.

Chelsea Hospital.

Governor.

Blakeney, Rt. Hon. Sir E. Gen. G.C.B. &c.

Lieutenant-Governor.

Woodford, Sir Alex. Gen. G.C.B. &c.

Major.

Wilson, Sir J. M. Col. C.B. K.H.

Physician and Surgeon.

Maclachlan D. M.D. Dep. Ins. Gen.

Adjutant.

Irby, J. J. C. Capt.

Captains of Invalids.

Edwards, Charles, Capt.
Dowman, John, Capt.

Quartermaster.

Farrier, Jas.

Assistant Surgeon.

Howison, Y. Howison, M.D.

Royal Hospital, Kilmainham, Dublin.

Master.

Brown, Sir George, Gen. G.C.B. K.H.

Deputy Master.

Brownrigg, J. S. Col. C.B.

Military Schools.

Assistant Inspector.

Gleig, A. C. Capt. R.A.

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Local Inspector.

Lacy, T. E. Col. Gibraltar.

Royal Military Academy at Woolwich.

Governor.

Wilford, E. N. Col. R.A.

Inspector.

Yorke, F. A. Col. R.E.

Assistant Inspector.

Gibb, C. J. Major R.E.

Captain Commandant and Paymaster.

Williams, E. A. Major R.A.

Military Branch.

Fitzhugh, H. T. Major R.A.
Gilmour, C. D. Lieut. R.A.

Professor of Fortification.

Bainbrigge, P. J. Lieut.-Col. R.E.

Professor of Artillery.

Owen, C. H. Major R.A.

Instructors in Fortifications.

Hutchinson, C. S. Capt. R.E.
Wilson, J. J. Capt. R.E.

Instructors in Artillery.

Dames, T. L. Capt. R.A.
Brackenbury, C. B. Capt. R.A.

Instructors in Surveying.

Binney, C. R. Capt. R.E.
Drayson, A. W. Capt. R.A.

Royal Military Asylum, Chelsea.

Commandant.

Crutchley, Chas. Col.

Secretary and Adjutant.

Adams, Edw. Lieut.-Col.

Quartermaster and Paymaster.

Cousins, Wm.

Royal Hibernian School at Dublin.

Commandant.

Mylius, Geo. Col.

Army Medical School at Chatham.

Professor.

Longmore, T. Dep. Ins. Gen.

MILITIA.

ENGLAND AND WALES.

Bedford (Light Infantry).

Colonel.

Gilpin, R. T.

Royal Berks.

Colonel.

Blagrave, John.

Royal Brecknock (Rifles).

Honorary Colonel.

Watkins, Lloyd V.

Lieutenant-Colonel Commandant.

Dickenson, Douglas J.

Captain.

Tupper, A. C.

Cambridge.

Captains.

Bendyshe, John.
Goodwin, Edward.

Royal Cardigan.

Lieutenant-Colonel Commandant.

Powell, W. T. R.

Captain.

Durham, P. F. Adjt.

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Royal Carmarthen (Rifles).

Lieutenant-Colonel Commandant.

Dynevor, Lord, Colonel.

Royal Carnarvon and Anglesey (Rifles).

Honorary Colonel.

Pennant, Hon. E. G. D.

Lieutenant-Colonel Commandant.

Williams, T. Peers.

1st Royal Cheshire (Light Infantry).

Adjutant.

White, C. H. Capt.

2nd Royal Cheshire.

Lieutenant.

Wakeman, W. A. J.

Cornwall Rangers (Rifles).

Lieutenant.

Vyvyan, R. H. S.

2nd Derby (Rifles).

Lieutenant-Colonel Commandant.

Cavendish, W. H. F.

Captain.

Arkwright, F.

1st Devon.

Captains.

Hogg, T. D.
Ridgway, Alex.

Dorset.

Lieutenant.

Herd, Chas.

Adjutant and Paymaster.

Smith, E. H.

2nd, or North Durham.

Major.

Cockburn, Alex.

Durham Artillery.

Lieutenant-Colonel.

Hall, Geo.

West Essex.

Captain.

Edenborough, H.

Essex Rifles.

Lieutenant.

Knobel, W. R.

Royal South Gloucester.

Captain.

Le Patourel, Henry.

Royal North Gloucester.

Captain.

Hunte, R. B.

Hampshire.

Colonel.

Winchester, Marquis of.

Majors.

Heathcote, E.
Digweed, W. H.

Captain.

Breton, P. R.

Lieutenant.

Riddell, R. C.

Hampshire Artillery.

Lieutenant-Colonel Commandant.

Burnaby, R. B. Col.

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1st Lieutenants.

Campbell, John R.
Staunton, G. S. L.

Assistant Surgeon.

Harrison, W. A.

Hants (Isle of Wight Artillery).

Captain.

Worsley, Francis.

Hereford.

Lieutenant-Colonel Commandant.

Northwick, Lord.

Major.

Symonds, T. P.

Captain.

Cox, R. S.

Hertford.

Captain.

Gaussen, F. C.

Huntingdon.

Major.

Manchester, Duke of.

East Kent.

Lieutenant-Colonel.

Dering, C. E.

Captain.

Pennefather, R. D.

West Kent.

Colonel.

Wilson, Sir T. M. Bart.

Captain.

Weller, T. M. M.

Kent Artillery.

Captain.

Waring, W. T.

1st Royal Lancashire.

Captains.

Feilden, H. M.
Noble, J. G.

2nd Royal Lancashire Rifles.

Major.

Wardlaw, Jas.

Captains.

Johnson, R.
Fitzgerald, P. S.
Rochfort, J. D.
Forde, M.

3rd Royal Lancashire.

Colonel.

Patten, J. W., A.D.C. to the Queen.

Captain.

German, Jas.

4th Royal Lancashire.

Lieutenant-Colonel Commandant.

Blackburne, J. J.

Major.

Phibbs, R.

Captain.

Barlow, Geo.

5th Royal Lancashire.

Major.

Greenwood, Jas.

Lieutenant.

Brockhurst, S. M. S.

6th Royal Lancashire.

Lieutenant-Colonel Commandant.

Pringle, J. H.

Royal Lancashire Artillery.

Lieutenant-Colonel Commandant

Atchison, Thos.

Major.

Middleton, Jas.

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Leicester.

Captains.

Mowbray, Geo. Thos.
Chapman, Wm. H.

Royal North Lincoln.

Honorary Colonel.

Tomline, George.

Royal London.

Captains.

Curling, J. B.
Connor, W. H. B.

Royal East Middlesex.

Lieutenant-Colonel Commandant.

Alcock, T. St. Leger.

Captains.

Robertson, W.
Cole, G. C.
Speer, W. D.
Bent, W. H.
Mangles, W. H.

Surgeon.

Dalton, F.

2nd or Edmonton Royal Rifle Regiment.

Honorary Colonel.

Strafford, Earl of.

Captains.

Maycock, D.
Ottley, E. J.
Smith, J.
Read, C. H.
Stephens, F. S. M.
Byass, F.

Lieutenant.

Stephenson, B. C.

Assistant Surgeon.

Godson, Charles.

3rd Royal Westminster Middlesex Light Infantry.

Captains.

Burgess, W. H.
Swan, J. P.

4th or Royal South Middlesex.

Lieutenant-Colonel Commandant.

Scriven, John.

Major.

Kirby, C. F.

Lieutenant.

Jones, W. P. d'Allington.

Royal Elthorne, or 5th Middlesex.

Captains.

Lane, George.
Campbell, R. McDonell.

Royal Monmouth.

Lieutenant-Colonel Commandant.

Vaughan, J. F.

Captain.

Carter, J. M. Adjt.

Ensign.

Allaway, W. A. H. K.

Royal Montgomery and Merioneth Rifles.

Lieutenant-Colonel Commandant.

Morgan, E.

2nd or East Norfolk.

Captain.

Haggard, W. M. R.

Northampton.

Lieutenant-Colonel Commandant.

Burghley, Lord, A.D.C. to the Queen.

Captain.

Hatton, E. F.

Nottingham, or Royal Sherwood Foresters.

Lieutenant-Colonel.

Mellish, W. L.

Northumberland.

Lieutenant-Colonel Commandant.

Bigge, W. M.

Major.

Lovaine, Right Hon. Lord.

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Oxford.

Colonel.

Bowles, C. O.

1st Somerset.

Honorary Colonel.

Tynte, C. K. K.

2nd Somerset.

Captain.

Harwood, Edwd.

The King's Own, 2nd Stafford.

Colonel.

Littleton, Hon. E. R.

Captain.

Salt, Thos.

3rd (King's Own) Stafford Rifles.

Honorary Colonel.

Bagot, Charles.

Suffolk Artillery.

Colonel.

Bence, H. B.

Lieutenant-Colonel Commandant.

Adair, R. A. Shafto, Col. A.D.C. to the Queen.

1st Royal Surrey.

Lieutenant-Colonel Commandant.

Evelyn, G. P.

Major.

Scott, G. D.

Captain.

Forbes, Stewart.

Lieutenant.

Godbold, A. B.

3rd Royal Surrey.

Captain.

Flower, Lamorock.

Royal Sussex.

Lieutenant-Colonel.

Lennox, Lord A.

Major.

Gage, Hon. H. E. H.

Surgeon.

Batley, W.

The King's Own Light Infantry.

Lieutenant-Colonel Commandant.

Grant, W. L.

Major.

Parry, F. J.

The Queen's Own Light Infantry.

Colonel.

Wilton, Earl of, G.C.H.

Lieutenant-Colonel.

Walker, Sam.

Major.

Cooper, Henry.

Captains.

Dixon, Wm.
Lawrence, E. E.

1st Warwick.

Captain.

Baxter, S. S.

2nd Warwick.

Lieutenant.

Norris, G. G.

Royal Wiltshire.

Honorary Colonel.

Broughton, Lord, G.C.B.

Lieutenant-Colonel.

Methuen, F. H. P. Lord, A.D.C. to the Queen.

Captain.

Sloper, N. W.

Worcester.

Captain.

Domvile, W.

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East York.

Captain.

Grimston, M. J.

North York.

Lieutenant-Colonel Commandant.

Wade, H. C. C.B.

2nd West York.

Colonel.

Smyth, J. G.

Captain.

Brown, H. C. Newton.

4th West York.

Lieutenant-Colonel Commandant.

Massey, Hon. N. H. C.

Captain.

Hare, H. J.

5th West York.

Captains.

Craven, C. D.
Sole, H. W.

Lieutenant.

Williams, L.

6th West York.

Lieutenant-Colonel Commandant.

Hind, Charles. C.

SCOTLAND.

Royal Aberdeenshire Highlanders.

Captains.

Farquhar, A.
Dawes, E. A., Adjutant.

Argyll and Bute.

Lieutenant-Colonel Commandant.

Campbell, John. C.

Royal Ayrshire and Wigton.

Lieutenant-Colonel Commandant.

Ferguson, Sir Jas. Bart.

Dumfries, Roxburgh, and Selkirk.

Majors.

Johnstone, Hon. H. Butler.
Walker, Geo.

Captains.

Lennock, G. J.
Malton, W. D.

Fife Artillery.

2nd Lieutenant.

Waite, J. S.

Royal Perth Rifles.

Honorary Colonel.

Moncrieffe, Sir Thos.

Lieutenant-Colonel Commandant.

Drummond, Hay Henry M.

Ross Rifles.

Honorary Colonel.

Fraser, C. McKenzie.

IRELAND.

Clare.

Lieutenant-Colonel.

Macnamara, F.

North Cork Rifles.

Lieutenant-Colonel.

Stawell, W. St. Ledger Alcock.

Lieutenant.

Leahy, E.

Donegal.

Lieutenant-Colonel Commandant.

Hamilton, Lord Claud.

Major.

Todd, Jas. H.

Donegal Artillery.

Lieutenant-Colonel Commandant.

Fisher, R. Roe.

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Royal South Down.

Colonel.

Downshire, Marquis of.

Captain.

Balcombe, Jas. Adjt.

Dublin City Artillery.

Major.

Brettingham, R. W.

Fermanagh.

Colonel.

Enniskillen, Earl of.

King's County.

Colonel.

Rosse, Earl of, K.P.

Leitrim Rifles.

Major.

Forbes, the Hon. W. F.

Limerick County.

Honorary Colonel.

Clare, Right Hon. Earl of.

Limerick City Artillery.

Major-Commandant.

Vereker, Hon. S. P.

Queen's County Rifles.

Lieutenant-Colonel Commandant.

Dunne, F. P. c.

Royal Tyrone Fusiliers.

Major.

Caulfield, J. A.

CHANNEL ISLANDS.

Royal Jersey.

STAFF.

Adjutant-General.

Le Couteur, John, Col. A.D.C. to the Queen.

St. Helier Battalion.

Lieutenant-Colonel Commandant.

Hemery, Clement.

Lieutenant.

De Gruchy, W. L.

Royal Guernsey.

Colonel.

Priaulx, Jas. A.D.C. to the Queen.

YEOMANRY CAVALRY.

Buckinghamshire (Royal Bucks).

Colonel.

Duke of Buckingham and Chandos, K.G.

Major.

Knox, Brownlow.

Captains.

Holmes, T. Knox.
Hibbert, F. D.

Buckinghamshire.

Captain Commandant.

Orkney, Earl of.

Cheshire.

Lieutenant-Colonel.

Egerton, Sir P. de M. Grey.

Captains.

Davenport, A. H.
Hill, Hen. Adjutant.

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Denbighshire.

Lieutenant-Colonel.

Tottenham, C. J.

Royal North Devon (Mounted Rifles).

Lieutenant-Colonel Commandant.

Wheler, Sir Trevor, Bart.

Dorset.

Commandant.

Guest, M. J.

Royal Gloucestershire Hussars.

Captain.

Holford, R. S.

Hampshire.

Lieutenant-Colonel Commandant.

Eversley, Viscount, Col. A.D.C. to the Queen.

South Herts.

Captain.

Smith, H. J.

Royal East Kent (Mounted Rifles).

Captain.

Mount Charles, Earl of.

Cornet.

Filmer, Sir E. Bart.

Duke of Lancaster's Own.

Lieutenant-Colonel.

Ellesmere, Earl of.

Lancashire Hussars.

Lieutenant-Colonel.

Gerard, Sir R. T. Bart.

Major.

Gerard, F. S.

Captain.

Anderton, W. J.

Leicestershire.

Lieutenant-Colonel Commandant.

Howe, Earl.

North Salop.

Captains.

Hill, G. S.
Cust, H. F.

North Somerset.

Captain.

Jolliffe, H. H.

West Somerset.

Colonel.

Portman, Hon. W. H. B.

Staffordshire.

Major.

Ackers, G. H.

Westmoreland and Cumberland.

Captain.

Lowther, Henry.

Royal Wiltshire.

Captain.

Goddard, A. L.

Yorkshire Hussars.

Captain.

Lawley, Hon. R. N.

1st West York.

Lieutenant Colonel Commandant.

Warncliffe, E. M. G. S. Lord.

Captain.

Stanhope, W. T. S.

2nd West York.

Lieutenant.

Clarke, C. Kenny.

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The Hon. Artillery Company of London.

Colonel and Captain-General.

Field Marshal H.R.H. The Prince Consort K.G. K.T. K.P, G.C.B. G.C.M.G.

Major.

Robinson, W. T.

Captains.

Biden, J.
Jordan, W. J.
Rough, W. H.
Blockley, J.

Lieutenants.

Lewis, A. J.
Field, J. W. P.
Fox, E.
Goepel, P. D.

Adjutant.

Potts, G. B. Capt.

Quartermaster.

Ballin, Geo.

VOLUNTEER CORPS.

ARTILLERY VOLUNTEERS.

13th Lancashire, 5th Company, Blackburn.

Captain.

Sturdy, J. B. S.

17th Dorsetshire, 2nd Company, Portland.

Captain.

Leather, J. T.

22nd Yorshire (East Riding), 1st Corps, Burlington.

Captain.

Crowe, Robert.

37th Wigton, 1st Company, Stranraer.

Captain.

Dalrymple, Viscount.

48th Yorkshire (West Riding).

Captain Commandant.

Ramsden, Sir J. W. Bart.

Mounted Rifle Volunteers, 1st Huntingdonshire.

Captain Commandant.

Manchester, His Grace the Duke of.

6th Northamptonshire.

Lieutenant.

Loyd-Lindsay, Robt.

RIFLE VOLUNTEERS.

2nd Middlesex, 1st Corps, Victoria, Kilburn.

Lieutenant-Colonel Commandant.

Wellington, His Grace the Duke of, Major-Gen. K.G.

Surgeon.

Croft, C. P. M.D.

11th Corps, St. George's.

Major-Commanding.

Lindsay, Hon. C. H.

12th Barnet, 6th Battalion.

Captain.

Taylor, W.

22nd (Queen's) Westminster.

Captain.

Styan, Arthur.

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3rd Lancashire, 6th Corps, 1st Manchester.
Lieutenant-Colonel Commandant.
Grey de Wilton, Viscount.

8th Bury.
Major.
Hutchinson, John.

4th Surrey, 1st Corps (South London).
Captain.
Stephenson, H. J.

6th Esher, 2nd Battalion.
Captain.
Fletcher, Sir Henry, Bart.

9th Richmond, 2nd Battalion.
Captain.
Ommaney, O.

17th Godstone, 3rd Battalion.
Lieutenant.
Sharp, John H.

20th Lower Norwood, 1st Battalion.
Captain.
Ouchterlony, John.

7th Oxford, 1st Corps, University of Oxford.
Honorary Colonel.
His Royal Highness Albert Edward Prince of Wales, K.G. Col.

9th Wiltshire, 9th Corps, Bradford.
Captain.
Pickwick, C. H. S.

10th Sussex.
STAFF.
Lieutenant-Colonel.
Moorsom, R.
Adjutant.
Matthews, F. P.

6th Corps, Petworth, 2nd Battalion.
Captain.
Winterton, Earl of.

17th Norfolk, 1st (City of Norwich).
Lieutenant-Colonel.
Brett, John D.

9th Loddon.
Captain.
Beauchamp, T. W. B. P.

18th Staffordshire.
STAFF.
Lieutenant-Colonels.
Vernon, G. A. (4th Battalion).
Newdigate, F. W. (2nd Battalion).

27th Comp. Patshall, 3rd Battalion.
Captain.
Dartmouth, W. Earl of.

21st Brecknockshire.
STAFF.
Major.
Lindsay, H. G.

1st Corps, Brecon, 1st Battalion.
Captain.
Raikes, Robt.

26th Kent.
STAFF.
Lieutenant-Colonels.
Thorold, G. E. Col.
Hardinge, C. S. Viscount.
Scott, E.

30th Yorkshire (West Riding).
Honorary Colonel.
De Grey and Ripon, Earl.

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33rd Aberdeenshire, 1st Corps, Aberdeen.

Captain.

Forbes, Sir W. Bart.

41st Warwickshire.

STAFF.

Lieutenant-Colonel.

Scott, Hon. C. G.

1st Corps (Birmingham).

Captain.

Ratcliff, Chas.

45th Somersetshire.

STAFF.

Lieutenant-Colonel.

Jones, Inigo, W.

48th Shropshire.

STAFF.

Lieutenant-Colonel Commandant.

Hill, Hon. W. N. Col.

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